THE

ELECTRICAL WORLD

VOLUME XXIV

FROM JULY 7 TO DECEMBER 29, 1894

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INDEX TO VOLUME XXIV.

GENERAL ALPHABETICAL INDEX.

NOTE.—Titles from Digest are indicated by (Digest); if merely references by (Digest, Ref.)

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

M.

N.

O.

P.

Q.

R.

U.

V.

W.

Z.

AUTHOR INDEX.

The Electrical World.

VOL. XXIV. NEW YORK, JULY 7, 1894. No. 1.

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1880	contained	25	different	adv'ts	1887	contained	154	different	adv'ts
1881	"	28	"	"	1888	"	175	"	"
1882	"	45	"	"	1889	"	234	"	"
1883	"	63	"	"	1890	"	289	"	"
1884	"	82	"	"	1891	"	325	"	"
1885	"	100	"	"	1892	"	316	"	"
1885	"	138	"	"	1893	"	317	"	"

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No announcements of the Publisher are included in this list.

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CONTENTS.

OUR NEW DRESS.

The new dress in which the present issue of The Electrical World appears, will, we trust, meet with the approval of our readers. Though somewhat smaller than the type from which the last volume was printed, the fonts here used approach more nearly in size those of the majority of technical papers, and will give an impression not less legible, we believe, than heretofore, and more in keeping with the size of the page. The less number of pages in an issue, while making the semi-annual volumes less unwieldy in size, will yet contain about ten per cent. more matter, thus bringing a welcome relief to the increasing press on our columns.

THE ELECTRICAL WORLD AT HOME.

In a supplement to the present issue, a profusely illustrated description of the new home of The Electrical World is presented in the belief that its readers will be interested to know something about the way a modern technical journal is conducted. Starting with humble quarters at No. 9 Murray street, it has thrice outgrown its offices and been compelled to seek new and more commodious accommodations, until finally, after years of wandering, it has returned and found an abiding place in the magnificent new Postal Telegraph Building, next door to its first home. The W. J. Johnston Company, Ltd., has now not only comfortable but elegant quarters, and possesses every facility for the disposal of its large and constantly increasing business. It may prove interesting to some of the readers of The Electrical World to follow its history, which is briefly traced in the supplement, from its birth many years ago, through the vicissitudes of its early days, down through the first years of electrical development, to its majority, into which it entered a few months ago.

COMPETITION WITH CENTRAL STATIONS.

An interesting question recently came up before the Massachusetts Board of Gas and Electric Light Commissioners, in regard to the right of the owners of an isolated electric light installation to run wires under a public highway to supply a neighboring building with current. In the specific case considered authority had been granted to the owner of a building by the Boston Board of Aldermen to lay pipes in an underground duct to supply another building with steam. When the trench was opened, in addition to the pipes for which authority had been given, another one was laid to carry electric wires, and the Board of Aldermen subsequently passed an order giving permission to use it for the purpose intended. Upon appeal to the State Board of Gas and Electric Light Commissioners, objection by a public electric lighting company to such use was sustained, on the ground that a business like that of transmitting electricity through the streets of a city must necessarily be transacted by a regulated monopoly and that free competition is impracticable. "It is clear," the opinion states, "that if isolated plants are permitted to exercise public franchises over limited areas in the city, the burden to each consumer of maintenance of the general companies will be enhanced; for such a removal of its customers, as would certainly happen by the multiplication of businesses like that conducted by the appellees in this case, would of necessity add to the cost of light to the whole community." The soundness of this argument cannot be disputed, for any general system of supply, whether of gas, water or electricity, would be impossible if through private competition the more profitable portions of territory were withdrawn. On the other hand it serves to draw attention to the great power that may be conferred by a franchise, and to the fact that a company holding such a grant has not only the character of a commercial enterprise but also that of a trustee for the public in the exercise of the powers conferred.

TWO PHASED MOTORS.

We print in full elsewhere the paper by Dr. Duncan and several of his students which was read at the Philadelphia meeting of the

American Institute of Electrical Engineers, and gives an account of experiments with a two phased motor. This forms another of the original contributions to the subject of multiphased phenomena which Dr. Duncan is in the custom of making, and demonstrates once more the great value of his contact method of obtaining alternating current curves. It will be noted that one of the conclusions of the experiments is that it is of great importance to design rotary field apparatus so that both the applied and counter E. M. F.'s shall follow the sine law. It is but a few years since a well known English electrician ridiculed the idea that there was an advantage in having alternating curves follow the sine law, but the deductions of Kennelly and these experiments both prove that the advantage is a real one and moreover of great practical importance, particularly, as shown by Dr. Duncan, in the case of large multiphased motors. It is also pointed out that self induction has a beneficial effect in damping fluctuations in the armature current, but it is not made clear whether there would be a balance of advantages to justify designing armatures with a very high self-induction. Two important points, however, in designing are brought out, relating to the conditions for securing the sine form of curve above referred to. It is shown that to satisfy these conditions projecting pole pieces for the field windings must be avoided, and the armature windings must be numerous, this latter requirement being only practically possible in larger machines. (In this connection we call attention to an abstract in the Digest of a German paper on some experiments with alternators to determine the form of their current curves and the conditions influencing the same.) The result of the experiments on larger motors, referred to at the conclusion of the paper, will be looked forward to with much interest, particularly as there has been a great lack of experimental data with which to test the various mathematical theories that have been advanced on the subject. Few of the latter, we venture to predict, will be shown to have much practical value on account of the inherent difficulties offered to such a treatment.

STORAGE BATTERY IMPOSSIBILITIES.

Occasionally we read in newspapers predictions of the possibilities of the coming storage battery, and some enthusiasts have even prophesied that when "perfected" ocean steamers will be propelled by this popularly misunderstood apparatus. While, of course, every one with an iota of electrical knowledge recognizes the absurdity of such a claim, yet an illustration of how absurd it is may be of interest, and to furnish this we will apply the necessary calculations to the case of the new Cunarder Campania. The best transatlantic time of which we have a record made by this ship, whose displacement is 18,000 tons, was 5 days, 12 hours and 15 minutes, during which the average speed was 21 knots, corresponding to about 26,000 average horse power and a consumption of coal for the trip of about 2,700 tons. Assuming storage batteries of 50 pounds to the hourly horse power, the entire weight of batteries to do the same work, and allowing for no reserve, would be 76,750 tons of 2,240 pounds, or more than four times the entire displacement of the ship. To determine the weight per horse power that a storage battery should have to compete with steam in the case under consideration, we will assume that the entire weight of the boilers and machinery of the Campania is 3,750 tons, which is probably near the actual weight. Adding the coal consumption for a trip, 2,700 tons, we have 6,450 tons as the entire weight of the electrical plant. Assuming the weight of the electrical propelling machinery to be 1,500 tons, we have finally for the total weight of the battery 4,950 tons. With these data we find that the weight of a battery, allowing for no reserve, would have to be 3.16 pounds per hourly horse power. How small this is can be appreciated from the fact that a 150-ampere hour cell would weigh on this basis only about 1¼ pounds, really about the weight of its lugs. A similar calculation would show the impossibility of storage batteries displacing locomotives, yet the writer knows of a company formed several years ago which spent several thousand dollars in attempting to perfect a battery for such a use. Much of the misconception in regard to the power of the storage battery must be ascribed to the sensational manner in which it was introduced to the public by a very great scientist, his statement in regard to holding "one million foot-pounds of energy" in his hand not yet having lost its effect. The great value of the storage battery in its proper field, which is of vast extent and as yet scarcely entered in this country, should be sufficient to satisfy its most sanguine friends. Only harm can come from making claims beyond its power to fulfil, and much harm in this way has been done, aside from the absurd instances we have here considered.

CANDLE POWER OF ALTERNATING ARC LAMPS.

In the Digest is an account of some elaborate experiments made in Germany with alternating current arc lamps, which brought out several points of much interest. It is stated that the quantity of light from an ordinary alternating arc depends upon the mean value of the current as distinguished from the square root of the mean square value. It follows that since the energy of the current is proportional to the latter, the efficiency of such an arc is greater the nearer the current curve approaches a rectangular shape. This, however, would lead to extreme inductance effects, as well as give rise, it is stated, to disagreeable noises, and the final conclusion of the experimenters is that the best ideal is a true sine curve. Another of the conclusions of the paper is that direct currents are more efficient for arc lighting than alternating currents. Taking a 450 watt (2000 c. p. nominal) arc lamp as a basis of comparison, we find that the mean spherical candle power of the same alternating lamps on three different machines was respectively 823, 907 and 970; while with the same energy and a direct current, 1292 candle power was developed with a direct current lamp. What is astonishing about these figures is the quantity of light produced from 450 watt lamps, and which, it seems, is even greater than represented, as a considerable loss in the reflector of the photometer is apparently not included. At the Philadelphia meeting of the American Institute of Electrical Engineers, several speakers, of whom one, Prof. Anthony, had made many hundred photometric measurements of arcs, concurred in upholding a statement that a 450 watt arc, enclosed by a clear glass globe, would not ordinarily give a mean spherical candle power of 500. As the absorption of the reflector of the photometer in the German experiment is stated to be 30 per cent., which is greater than that of a clear glass globe, the disparity is even greater than indicated by the candle powers in the two cases, though this amounts to 160 per cent. We cannot question the accuracy of the photometer measurements of Prof. Anthony, nor have we any reason to doubt those of the German experimenters. Neither can we ascribe the differences to lamp mechanism, or to adjustment; the latter in any case would be kept as nearly normal as possible. It would seem then that the only explanation left is that the disparity must be considered as due to differences in the carbon employed. It has long been known that the quantity of light from an arc materially depends upon the quality of carbon used, though we are not aware that any comparative experiments have ever shown anywhere as great a difference as above noted. We have been informed, however, by an arc light station superintendent of wide experience, that it is not unusual to come across carbons that will show a difference of 50 per cent. in the amount of light produced. As this is a matter of much importance to superintendents of arc stations and users of arc lights, we trust that one of our college laboratories will take advantage of the excellent opportunity it offers for investigation and experiment.

Melon Electricity.

A correspondent of an English contemporary claims, apparently seriously, that if twelve ripe melons are connected in series, with platinum wires inserted at the top and bottom, sufficient current is obtained to ring a bell. He adds that only a ripe melon gives a "strong current," and adds that cucumbers, apples, pears, carrots, etc., also give current, but not nearly as much. He makes the useless theoretical deduction that a battery of 10,000 melons will give enough current to run an electric motor of two brake h. p. We might add that if he had used copper and zinc wires instead of platinum, and had selected sour melons, the results would have been much more encouraging.

Invention of the Telegraph.

To the Editor of The Electrical World:

Sir:—Please accept my thanks for your courtesy in printing, in a recent issue, my communication. I did not intend to further trespass upon your columns, but I trust you will allow me the space in which to respond to the letter you published from Mr. Edward L. Morse.

Primarily, I desire to state emphatically that it is not the desire of the family of Alfred Vail, or of any of his friends, to claim any credit or game for his name than that to which, by all known principles of right, and fair, honest dealing, he is absolutely entitled. Neither is there any desire or intention to deprive S. F. B. Morse of the smallest degree of the credit which, to his name, is honestly and rightfully due.

Morse, in 1837, had constructed a rude wooden apparatus, by means of which he was able to record pencil marks (dots), in varying combinations (upon a moving fillet of paper), which, by laborious reference to a code or dictionary, were translated into intelligence. Previous to September, 1837, when he entered into a partnership contract with Alfred Vail, he had filed, in the Patent office, a caveat for his patent, in which, of course, were specified the features of his inventions. By the terms of the contract just mentioned it was stipulated that Alfred Vail should "devote his personal services and skill in constructing and bringing to perfection, as also in improving, the mechanical parts of said invention . . . . . . without charge for such personal services to the other proprietors, and for their common benefit." He was also required to construct, at his own expense, and exhibit before a Committee of Congress, one of the telegraphs, "of the plan and invention of Morse," and assume the expense of exhibiting the apparatus and of procuring patents in the United States, and in consideration he was to receive one-fourth of all right in the invention in the United States.

An impartial investigation of the claims of Morse, as found in his caveat of 1837, will reveal the fact that not a single one of the features therein specified, and upon which rest his claims to being "the inventor" of the electric telegraph, is to be found among the constituent features of the invention as it exists to-day and identical with that apparatus as it came from the hands of Alfred Vail in 1838, and later, in 1844, in no ways changed except in slight modification of form and size.

No one who has familiarized himself with the history of the invention, during the years following the time at which Morse and Vail left New York and went to Morristown, N. J., to continue (at the Speedwell Iron Works of Judge Stephen Vail, the father of Alfred) the experiments begun in the former city, need be told whose brain and mechanical skill wrought the changes, which, in following out the conditions of his contract, devolved upon Alfred Vail, and which eliminated completely from the apparatus all of the features that constituted the basis of Morse's first caveat for a patent.

A careful reading of the terms of that contract will show that, no matter what he might contribute to the improvement and perfection of the device of Morse, it must be done "without charge and for the common benefit of the proprietors," thus debarring him absolutely from taking out in his own name any patents for the independent creations of his brain. Everything he might do must be considered as a part of the patent granted originally to S. F. B. Morse. Is it difficult to understand how Alfred Vail became a cipher in so far as any public knowledge of his part in the invention was concerned?

Had he been disposed to assert his rightful claims to recognition as the real "inventor" of all of the so-called "improved Morse telegraph," he could not have done so and conscientiously observe the terms of his contract. Had not this detergent influence prevailed, business policy would have prevented him from raising an issue as to who was the inventor while innumerable suits brought by the patentees against infringements were in the courts. Unfortunately, Alfred Vail died before the expiration of the patent and while extensive legal contests were still pending.

In my possession is a paper upon which is written in my father's own writing the following statement, showing pretty conclusively the reasons why to the name of Morse has been given the credit for the invention of the recording receiver, the sounding key and the dot and dash alphabet, when it was not he who devised them, but Alfred Vail, who was debarred by his contract from claiming publicly the credit to which he was entitled:—

"This lever and roller were invented by me, in the sixth story of the New York *Observer* office, in 1844, before we put up the telegraph line between Washington and Baltimore, *and the same has always been used in Morse's instrument.* I am the sole and only inventor of this mode of telegraph embossed writing. Professor Morse gave me no clue to it, nor did any one else, and I have not asserted publicly my right as first and sole inventor because I wished to preserve the peaceful unity of the invention, and because I could not, according to my contract with Professor Morse, have gotten a patent for it."—Alfred Vail.

Mr. Edward L. Morse cites the fact that the Supreme Court upheld Morse's claims. That is quite true, but he forgets that the suit was *not* one brought by Morse to substantiate his claims against other claims made by Alfred Vail. The suit was, "Morse and others versus O'Reilly and others," for infringement, and has no bearing whatever on the point at issue, for all of the inventions of Alfred Vail were unknown to the Court, having been absorbed, according to the contract, by the Morse patent, the one in contest.

As a matter of fact, Chief Justice Taney did not sustain all of Morse's claims, and refused to recognize the eighth claim, as specified in his patent, condemning it as untenable. Alfred Vail sought in court to obtain the justice which he knew was due him from his copartner and associate, for that supposed friend had led him to believe, as he so often expressed it: "I am confident that Professor Morse will do me justice." He passed from earth in January, 1859, thirteen years and more before the death of Morse, and the justice awarded him by Morse may be judged of by the following incident:—

On the morning of the 10th of June, 1871, Morse was the recipient of a public reception at the Academy of Music, in this city, and before an audience that thronged that edifice delivered an address upon the telegraph, lasting an hour or two. No more fitting opportunity could have been presented than then—probably his last public appearance, and, too, when his remarks were to have a world-wide circulation—for this aged man to recognize in magnanimous terms the part that his long since deceased and unhonored associate had had in the invention, the fame and honor of which he had unhesitatingly accepted as his alone.

Did he allude to Alfred Vail? He did, and in these terms: "The telegraph found a friend, an efficient friend, in Mr. Alfred Vail, of New Jersey, who, with his father, *furnished the means* to give the child a decent dress, preparatory to its visit to the seat of government." No comment is necessary. That was all this old man, standing on the brink of the grave, could say of the friend and associate to whom he was indebted for all in the electric telegraph that bore the name of "Morse."

Four weeks prior to the day of Morse's death (the following year), a member of the family of Alfred Vail sat by the side of his sick bed, and during the visit of two hours, Morse frequently said: "The one thing I want to do now, is justice to Mr. Vail."

That justice was neither rendered by him before he died, nor since by any of those whom he left behind.

New York City. STEPHEN VAIL.

The First Telegraph Station.

To the Editor of The Electrical World:

Sir:—The first telegraph station established in the world was blown down by the fierce gale of last week. It was a gigantic tree in the forks of which Morse and Smith placed their first crude apparatus for the line extending from Smith's house to the tree where Morse received the first message sent by an aerial line. The tree was used because the rustics of Cumberland County, Maine, refused to lend their barns or houses as a receiving station for a wire that in their opinion conveyed messages from the abode of the powers of darkness, and the Selectmen of the town were berated in town meeting for allowing the founders of telegraphy to stretch wires along the highway where man and beast were exposed to danger and death from lightning catchers. Men still living in the town remember a sermon preached against Morse and Smith in which they were termed impious wretches who would be eternally confounded for seeking to pry into the secret places of the Almighty. So much opposition was made to the aerial wires that underground conduits were laid, and that so skillfully, and of such good materials, that a piece which I dug up ten years ago was as good as the best made to-day, whilst the house conduits made by the same parties of tarred paper and used in several houses near by is of much better quality than several brands on the market to-day.

I happened to be in the vicinity of the tree when the gale uprooted it, and purchased it, so if any electrician would like a piece of it he can have it so long as the supply (four cords) will hold out.

New Brunswick, N. J. G. WILFRED PEARCE.

The Most Powerful Light in the World.

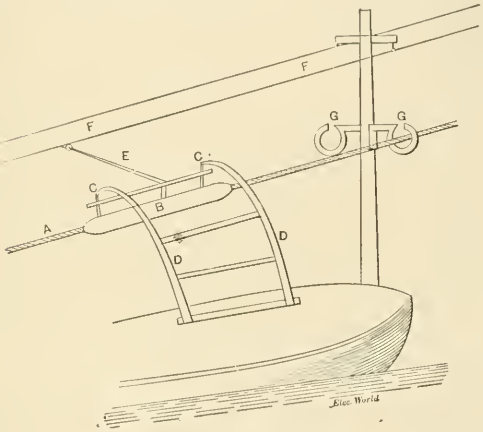
An electric light is to be placed in the Fire Island lighthouse, off New York, the candle power of which is estimated to be 450,000,000 candles.

Electricity on the Canals.

BY M. W. HASSAN.

I have been much interested in the subject of introducing electricity as the motive power on our canals, especially the Erie, in New York State, and have read all the various plans that have come under my notice, as published. The simplest one is the double trolley, using the propeller wheel in the water, the chief objection to which is the wash of the banks caused by the propeller, which would tend to weaken the banks and cause breaks. I take the liberty of enclosing a sketch of a system which is an adaptation of a telpher system, which was illustrated and described in your issue of December 20, 1890.

The poles are placed in the middle of the canal and support two working conductors and two trolley wires. The conductor and trolley wire on the right of the pole are for boats going east, and the conductor and trolley wire on the left of the pole are for boats going west. I have shown but one of the working or hauling conductors, in order not to complicate the sketch, but the other is a



Electric Canal Boat System.

duplicate of the one shown. The conductor, A, is ridged spirally or screw shaped, and the motor inside of the clyinder, B, has a cylindrical armature, which is grooved to fit the conductor, A, and, turning in one direction, propels the boat forward, and reversed propels the boat backward. The frame, C C, and stanchions, D D, support the motor, so that its weight rests upon the boat, and not upon the conductor, A. The trolley, E, completes the circuit from the conductor, A, which acts as a return from F, after the current traverses the motor. The hooks, G G, support the hauling cable, A, and have an opening sufficiently large to permit the passage of the frame, C C, and too small to allow the cable, A, to work out of its place. The hooks, G G, are insulated, and through them pass the motor. All that is necessary upon the boat is the switch, and perhaps a rheostat similar to that of a motor car. It is well for the boat to have a rudder, but it need not be used while the boat is being pulled, for the boat is guided by the cable, as the frame, C C, and cylinder, B, may be of any suitable length, even to the length of the boat, which will insure a steady pull and even purchase on the cable. The boat can also be lighted the same as a motor car, as the wire connections to the switch come down the stanchions, D D, to the boat and can be run into the light circuit also.

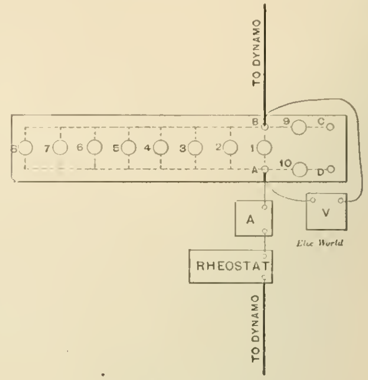
A Convenient Lamp Rheostat.

BY GEORGE A. HOADLEY.

Probably nothing is of more value to the young engineer than the ability to adapt the materials at hand to the work to be done, and there is no place where this is more called for than in an average electrical laboratory. In order to combine a lamp rheostat with a method of studying the principles of parallel and series lighting, the following lamp board was devised, and has been found of very great service. The only materials required can be found in any laboratory or lighting station, and consist of ten lamps and sockets, four binding posts, a yard of good-sized copper wire for connectors, and a base board, 6 inches wide and 30 inches long.

Believing that any instrument is better cared for and more carefully used if well made and tastefully finished, a black walnut board, 1 inch thick, was used for the base. This was carefully planed, sand papered, filled and finished with hard oil.

In the sketch, the dotted lines show the connecting wires that are



Lamp Rheostat.

fastened in grooves on the under side of the board. The binding posts are designated by letters, and the lamps by numbers.

By connecting with binding posts, A and B, a single lamp can be thrown in, or parallel circuits of from two to eight lamps can be used.

In the work done with this, the sources of E. M. F. at hand were a dynamo giving 120 volts, and storage batteries giving 40 volts. The lamps at hand were 40-volt lamps, of a resistance of 60 ohms.

By coupling, as indicated in the sketch, a rheostat and an ammeter in series with the terminals, A and B, while a voltmeter is coupled as a shunt with the same terminals, and a second voltmeter is also coupled as a shunt to the terminals of the dynamo, a most instructive study can be made of the problem of parallel distribution, including the relations between potential difference at the terminals of the dynamo, fall of potential due to the lamps, rheostat, ammeter and leads, and the parallel resistance of different numbers of lamps.

By coupling at terminals, A and C, lamps 1 and 9 can be put in series, and the essential differences between the voltages, resistances and currents used in series and parallel distribution can be very clearly demonstrated.

By coupling at the terminals, C and D, three lamps can be thrown in in series, giving the maximum resistance of 180 ohms. By throwing lamp No. 9 in series with the different parallel arrangements of the first eight lamps, a new group of resistances is introduced, and by throwing in bot i lamps Nos. 9 and 10, a still wider range is given.

The following table shows the possibilities when the lamps are of uniform resistance. For the sake of convenience, the arrangements are placed in the order of their resistances. Lamps of different resistances may be used, and with these the number of combinations and resistances is very greatly increased.

Arrangement.	Lamps in Circuit.	Resistance.	Current.
a.	9, 10 & q.	180.	.222
b.	9, 10 & r.	150.	.266
c.	9, 10 & s.	140.	.286
d.	9, 10 & t.	135.	.296
e.	9, 10 & u.	132.	.303
f.	9, 10 & v.	130.	.308
g.	9, 10 & w.	128.6	.311
h.	9, 10 & x.	127.5	.314
i.	9 & q.	120.	.333
j.	9 & r.	90.	.444
k.	9 & s.	80.	.500
l.	9 & t.	75.	.533
m.	9 & u.	72.	.555
n.	9 & v.	70.	.571
o.	9 & w.	68.6	.583
p.	9 & x.	67.5	.592
q.	1	60.	.666
r.	1, 2	30.	1.333
s.	1, 2, 3	20.	2.000
t.	1, 2, 3, 4	15.	2.666
u.	1, 2, 3, 4, 5	12.	3.333
v.	1, 2, 3, 4, 5, 6	10.	4.000
w.	1, 2, 3, 4, 5, 6 7	8.6	4.666
x.	1, 2, 3, 4, 5, 6, 7, 8	7.5	5.333

The fact that all changes are made by simply snapping on the lamps, makes this board a very satisfactory one to use.

Swarthmore College, Swarthmore, Pa.

A Central Station on the Pacific Slope.

The California Electric Light and Edison Light & Power Company has three stations, two of which are located in the heart of the business portion of the city, and the third on the south side, near the water front. Stations A and B, in the center of the city, are in the same building, but the operation of the two is entirely separate. Station A was the original arc station, and was started before incandescent lighting had taken its place in the world. At present it contains thirteen 60-light arc dynamos, divided between machines of the Brush and Thomson-Houston types, and nine 1,000-light alternating dynamos (2,000 volts)—six Brush and three Slattery. The arc switchboard is an old and primitive affair in which the electrician takes no pride. It is soon to be replaced by a steel fireproof board of modern design.

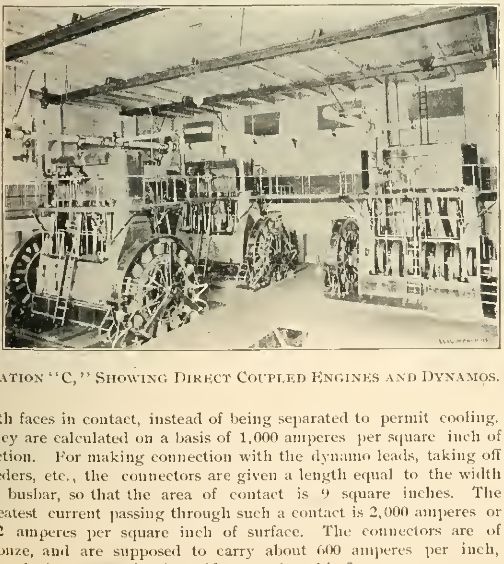
Station B is devoted entirely to the operation of arc dynamos, of which there are sixty-two, divided between Brush and Wood types, the Brush being 60-light and the Wood 80-light. They are used to a considerable extent for furnishing power by means of constant-current motors.

There are in all 2,500 arc lamps in circuit, the longest circuit being twenty-eight miles.

Station C is the Edison station, and is modern in all its appointments, as will be seen from the views given. The dynamos are of the Edison multipolar type, direct driven by triple expansion engines. There are at present installed one engine of 400 h. p., driving two 100 kw. dynamos, and three 800 h. p. engines, each driving two 200 kw. dynamos of fourteen poles each at 180 revolutions. Foundations are built, ready to receive two more of the larger units when the output of the station makes their use necessary. The smaller engine is sufficient for the present day load.

The foundation for all the dynamos consists of a solid block of concrete, covering the whole area of the dynamo room and extending five feet below the surface. Extra thicknesses of five feet are built up at the immediate location of the engines. This foundation rests on sand and is entirely disconnected from the walls or floor of the building, so there is very little vibration. The small amount can be judged from the fact that in taking the views given, the camera was standing on the gallery immediately over a running engine, and the exposure was three-quarters of an hour. The sharpness of detail is evidence of the absence of vibration.

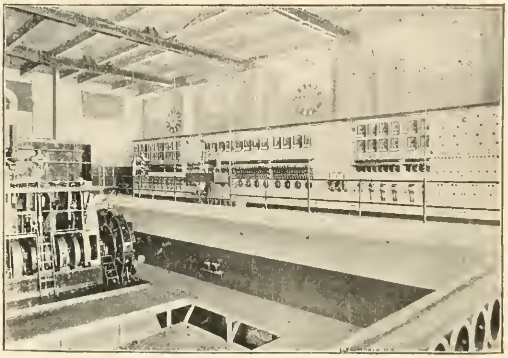
In accordance with the latest practice, the switchboard is placed on the gallery overlooking the dynamo room. It is fenced off at both ends by means of lattice-work iron doors, these being provided mainly to keep out strangers who may be permitted to see the station. The boards are of white marble, with the instruments, switches, etc., on the face and all busbars and connectors on the back. The busbars are made of 3x½-inch bars, but where extra capacity is required, two or three such bars are secured together,



Station "C," Showing Direct Coupled Engines and Dynamos.

with faces in contact, instead of being separated to permit cooling. They are calculated on a basis of 1,000 amperes per square inch of section. For making connection with the dynamo leads, taking off feeders, etc., the connectors are given a length equal to the width of busbar, so that the area of contact is 9 square inches. The greatest current passing through such a contact is 2,000 amperes or 222 amperes per square inch of surface. The connectors are of bronze, and are supposed to carry about 600 amperes per inch, though the current density seldom reaches this figure.

Nothing in the nature of equalizers, boosters, etc., is used for regulation, the electrician being of the opinion that the constant loss incident to the use of these can be better applied as interest on the capital invested in extra copper. Extra feeders are put in, and the regulation effected by means of them and the field rheostats. Work begins at light loads with the rheostats thrown in the fields, and a man stationed at the switchboard, in plain view of the voltmeters connected with the feeding centers. As the load comes up and the pressure falls, resistance is thrown out of the fields, until it is so far exhausted that the pressure cannot be kept up. Then, when any feeding center shows a pressure below normal, extra feeders are cut in, so as to reduce the drop, and at the same time the rheostat is inserted in the field, so it can be used for regulation, as before. Obviously, by having a sufficient number of feeders properly calculated, good regulation can be maintained by this means, provided the attendant is sufficiently watchful.



Station "C," Showing Switchboard.

Weston station voltmeters are used, each one being provided with red and blue lamps, and contacts arranged so one or the other will light up if too great a variation from normal pressure is permitted.

In the office of the electrician is a group of Bristol recording voltmeters, connected with the various feeding centers, by means of which an approximate record of the larger pressure variations is kept. They cannot, of course, register with extreme accuracy even the larger variations, and must fail to record small ones altogether, as the friction is appreciable. But for this purpose extreme accuracy is unnecessary.

There are also two other recording voltmeters, employing an entirely new principle. They are made after the designs of the electrician, Mr. F. E. Smith, and have never been described. They are very sensitive, and as the design is novel and ingenious, a description of them will not be uninteresting.

Referring to the view, a duplicate construction will be seen, one for the positive and the other for the negative side of the three-wire system. The Weston voltmeters shown are not connected with the recording meter, but simply show the actual voltage.

Considering one side only, the dial shown is rotated once every twenty-four hours by means of clockwork within the case, and the pressure is recorded on it by means of red ink carried in a well on the end of the hand. Underneath the Weston meter will be seen a round disc of ebonite, about 8 inches in diameter, carrying at the top a lamp and at the bottom a helix. These are in series, and are connected through pressure wires to the feeding center, which is the standard to which all the others are regulated. The lamp burns at about half-power, and is used because any variation of pressure, in virtue of which the current through the lamp changes, causes a considerable variation in the resistance of the filament, and hence makes the current change a maximum for any given change of pressure. A core within the helix has the lower half of iron and the upper half of brass. It is supported by two very flexible brass strips shown, which also form part of electric circuits. Near the ends of the core are two binding posts, with adjustable contacts, and in the normal position of the core the two strips lie just clear of these contacts. The motor shown is a small Edison slowspeed, series-wound motor, connected to run in either direction. The vertical rod shown is revolved by the motor through bevel gears, and revolves the disc through worm gearing, as shown. A wire is stretched between the disc and the hand on the dial, and when the disc rotates, the hand moves through a small arc and makes the record.

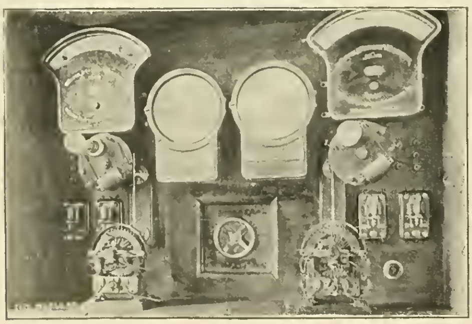
The core of the helix tends to fall by gravity until the lower strip comes against the lower contact, which tendency is opposed by the current through the helix, which draws the core upward until the upper strip makes contact.

The motor is connected with the service mains in the building, the relays shown being inserted to break the circuit. The current through the strip contacts simply controls the current through the relay, and only a battery current is necessary, thus reducing the spark, which would soon destroy the accuracy.

If the pressure falls below normal, the action of the helix is weakened and the core drops until the lower contact is closed, thus allowing current to pass to the motor in such a direction that the disc is revolved clockwise until a balance is obtained. This movement is registered on the dial. If the pressure rises, the core is drawn upward until the upper strip makes contact, when the motor revolves the disc counter-clockwise. Thus the slightest variation of pressure will cause the motor to revolve, and as considerable power is available for overcoming the friction, the instrument is very sensitive. In place of gravity, the action of the helix can be balanced against a flat spiral spring such as is used in Weston instruments.

Mr. Smith has applied this principle to an engine governor and a revolution indicator. Methods for doing this are obvious.

The only other arrangement of special importance connected with the station is the method of obtaining water for condensing purposes. Leading into the arc station near the water front is a culvert (the length of which is about one-eighth of a mile), which discharges water by natural flow into a well beneath the station. Powerful



REGISTERING VOLTMETER.

pumps then force it through iron pipes to the incandescent station, where it passes through the condensers and thence to the sewer. The saving by condensation is far more than the cost of forcing the water, interest on condensing plant, etc.

The arc dynamos are belted in groups from long countershafts, and cannot be slowed down singly. Some are shut down by short-circuiting the fields and some the armatures, the latter method being preferred. When the new switchboard is put up for Station A, arrangements will be made so that if an armature is burning out, and it is desired to throw the load on another machine, the act of plugging in the second will short-circuit the field or armature of the first.

The arc and alternating lines are all overhead, but for the low-tension system Edison tubes are used, these being the only subway circuits in the city, except a few for telephone service. A long gallery leading under the street carries the feeders to the tube ends.

There are altogether about 50,000 16-c. p. lamps wired in the city, the farthest from station being about 5 miles, the greatest distance for the low-tension system being 1½ miles.

The original station, A, has 1,400 h. p. of horizontal boilers, but the other two stations use vertical tubular boilers, as taking up less floor space. Station B has 5,600 h. p., and Station C, 7,000 h. p. Jones under-feed stokers are used and are said to give excellent results.

The company has recently adopted the practice of wiring buildings and charging only the actual cost. This means that the house owners can have the work done at the lowest possible rate, as the company's facilities are better than those of private contractors. It is expected many will take advantage of the good terms offered, and that there will be a consequent large increase in the station output.

The Inductance and Capacity of Suspended Wires.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

The inductance and capacity of conductors employed in transmitting continuous currents do not usually call for consideration. For example, those who have designed, installed or operated Edison systems of incandescent lighting do not usually have occasion to inquire into the inductance or capacity of their circuits. On the other hand, where intermittent or alternating currents are employed, as in telegraphy or alternating current transmission, the inductance and capacity of the circuit often form important factors in their operation, and thus claim the attention of the electrical engineer.

Some of the problems connected with telephony and with the distribution of power by alternating currents, demand a knowledge of the inductance and capacity of the conductors, in addition to their resistance and insulation. To meet this demand in the case of overhead wires, the tables and curves which follow have been constructed.

Before considering these tables and curves, a few remarks on capacity may be acceptable, a subject which gives rise to much misunderstanding.

The capacity per mile of 5280 feet each of a pair of parallel wires (Fig. 1), of radius, a, suspended in air at an interaxial distance, d, is in microfarads

$$C = \frac{0.01942}{\log \frac{d}{a}} \qquad (1)$$

For example, if two bare but insulated No. 6 B & S. wires, each 0.081 in radius, are suspended in air at an interaxial distance of 24 inches, their capacity per mile will be

$$\frac{0.01942}{\log \frac{24}{0.081}} = \frac{0.01942}{\log 296.3} = \frac{0.01942}{2.47173} = 0.007858 \text{ microfarads.}$$

In other words, if a battery of one volt E. M. F. were connected with its terminals to one mile of each of these wires, one wire would

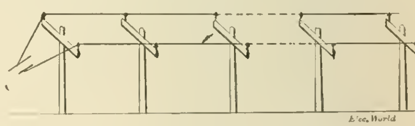


FIG. 1.

have 0.007858 coulomb of positive, and the other wire, 0.007858 coulomb of negative charge. (Fig. 1.)

This formula assumes that the distance between the wires is large, compared with the radius of the wire, as, indeed, is the usual case with overhead conductors. When, however, the wires are brought so close together that $\frac{d}{a}$ is a small number, their capacity is slightly greater than that given by the formula. The correction amounts to .5 per cent. when $\frac{d}{a} = 10$ and 2.6 per cent. when $\frac{d}{a} = 5$

When, as in telegraphy, a ground return circuit is employed, and the conductor is situated at an elevation h above the conducting surface of the ground, the capacity of that conductor is just twice as great as though the ground were removed and a return wire placed parallel at an interaxial distance $2h$ from the conductor. Thus in Fig. 2, if A be the conductor of radius a situated at the elevation h above the *conducting* ground level $G\ L$, the capacity will be the same as if the ground were entirely removed and a duplicate or similar return wire B were employed as the return circuit of A at a distance h below $G\ L$ or $2h$ from A, so that since the capacity of A with the imaginary wire B would be $\frac{0.01942}{\log \frac{2h}{a}}$ microfarads per mile, the capacity of A to ground will be $\frac{0.03884}{\log \frac{2h}{a}}$ microfarads. (2)

Thus, a No. 9 A. W. G. wire of radius 0.0572 inches, suspended at a distance of 20 feet, or 240 inches above the ground, should have a capacity of

$$\frac{0.03884}{\log \frac{480}{0.0572}} = \frac{0.03884}{\log 8391} = \frac{0.03884}{3.9238} = 0.0099 \text{ micro. per mile.}$$

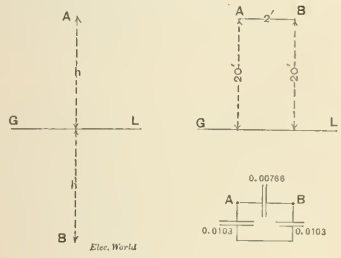
Since, however, the measured capacity of suspended wires is often 50 per cent. greater than their capacity calculated in this way, it

has sometimes been supposed that the insulators upon which the wire is supported account for the excess. While the presence of the insulators, with their pins and supporting cross arms, must add to the capacity of the wire, a closer examination shows that even where iron poles and brackets are used, with iron pins in the insulator connected with the ground, and where the outer surface of the insulator is covered with a film of moisture, the capacity of the line can only be increased from this cause by about 1-500ths of a microfarad per mile; while under ordinary conditions the additional capacity due to insulators can only be a small fraction of this amount, and is for all practical purposes negligible.

The excess of the measured capacity over the capacity calculated by formula (2) appears to be entirely accounted for by the presence of neighboring wires, supported on the same poles, as shown by Mr. Oliver Heaviside, in 1880.

If a wire be suspended on poles among a number of other parallel wires, its capacity will not be effected if these wires are all perfectly insulated, but if they are grounded or imperfectly insulated, its capacity may be more than doubled by their presence.

It is commonly supposed that when two parallel wires are supported on poles, their capacity, when insulated from the ground, as



FIGS. 2 AND 3.

in Fig. 1, depends largely upon their distance above the surface of the ground. Thus, if the two wires have in free space or at an indefinitely great distance above the surface of the earth, a capacity of 0.00786 micros per mile, according to formula (1), and each would have a capacity to ground of $+\dfrac{0.03884}{\log\dfrac{480}{0061}} = 0.0103$ microfarads per mile, according to formula (2), therefore, as represented in Fig. 3, it might be supposed that the total capacity between the wires at 20 feet elevation would be $0.00786 + \dfrac{0.0103}{2} = 0.013875$ microfarads per mile.

Such, however, is not the case, and as long as the insulation of the wires is maintained, their elevation above the surface of the ground has practically no effect upon their capacity. Thus, while formula (1) gives their capacity per mile for an infinite elevation, as 0.00786 microfarads, their capacity per mile for 5 feet elevation as 0.00788 microfarads, and their capacity per mile for 1 foot elevation, as 0.008362 microfarads, descent to within 5 feet of the ground only increases the capacity by about ¼ of 1 per cent., and descent to within 1 foot of the ground only adds about 6.4 per cent. Similarly, the presence of other grounded wires in the neighborhood has very little influence on the capacity of the insulated pair. For all practical purposes, therefore, the capacity of two overhead insulated wires is assigned by formula (1), and is not affected by the proximity of the ground or of other wires. Their induction is also for each wire:

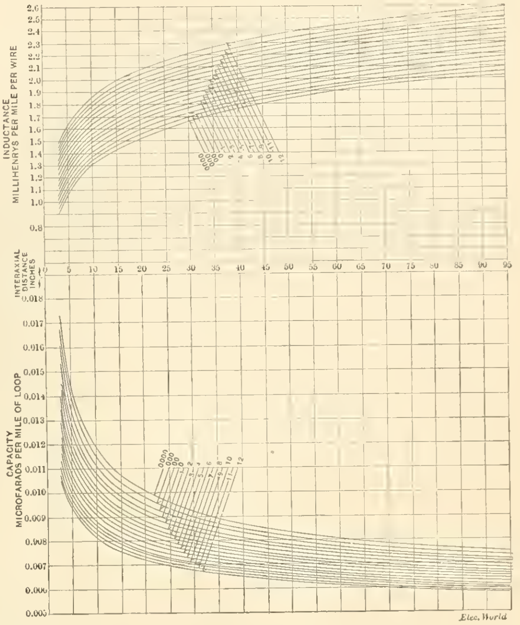


FIG. 4.

$$l = 0.0805 + 0.741 \log \frac{d}{a} \text{ millihenrys per mile.} \quad (3)$$

For No. 6, A.W.G. wires at 24″ $\log \dfrac{d}{a} = 2.47173$ as previously observed, so that $l = 0.0805 + 1.8315 = 1.912$ millihenry per mile.

The inductance of the loop formed by both wires would be twice this amount, or 3.824 millihenrys per mile.

An iron telegraph or telephone wire has about 12 millihenrys per mile more inductance than a copper wire, so that for each pair of iron wires we may take

$$l = 12.08 + 0.741 \log \frac{d}{a} \text{ millihenry per mile approx.} \quad (4)$$

The following tables and curves (Fig. 4) indicate the capacity and inductance of insulated, overhead wires, in microfarads and millihenrys per mile of 5,280 feet.

TABLE OF INDUCTANCES PER MILE OF 5,280 FEET OF COPPER WIRE WHEN SUSPENDED IN PARALLEL PAIRS—MILLIHENRYS.

Interaxial Dis. Ins.	0000 0.460″	000 0.4096″	00 0.3648″	0 0.3249″	1 0.2893″	2 0.2576″	3 0.2294″	4 0.2043″	5 0.1819″	6 0 1620″	7 0.1443″	8 0.1285″	9 0.1144″	10 0.1019″	11 0.09074″	12 0.08081″
3	0.907	0.944	0.982	1.019	1.056	1.094	1.131	1.168	1.206	1.243	1.280	1.317	1.355	1.392	1.429	1.467
6	1.130	1.168	1.205	1.242	1.280	1.317	1.354	1.392	1.429	1.466	1.503	1.540	1.578	1.615	1.652	1.690
9	1.260	1.298	1.335	1.372	1.410	1.447	1.485	1.522	1.559	1.596	1.634	1.671	1.709	1.746	1.783	1.820
12	1.353	1.391	1.498	1.465	1.502	1.54	1.577	1.614	1.652	1.689	1.727	1.764	1.801	1.838	1.875	1.913
18	1.484	1.521	1.558	1.596	1.633	1.671	1.708	1.744	1.781	1.820	1.857	1.894	1.931	1.968	2.007	2.044
24	1.576	1.614	1.651	1.688	1.725	1.764	1.800	1.838	1.875	1.912	1.949	1.986	2.025	2.061	2.099	2.135
30	1.648	1.686	1.723	1.760	1.797	1.835	1.871	1.910	1.947	1.984	2.021	2.058	2.097	2.134	2.171	2.208
36	1.707	1.745	1.784	1.818	1.856	1.893	1.931	1.968	2.005	2.043	2.079	2.117	2.155	2.192	2.229	2.266
48	1.799	1.836	1.874	1.911	1.949	1.986	2.023	2.061	2.099	2.135	2.172	2.209	2.248	2.285	2.322	2.359
60	1.871	1.909	1.946	1.982	2.023	2.058	2.095	2.132	2.169	2.208	2.245	2.282	2.319	2.356	2.393	2.432
72	1.930	1.968	2.005	2.042	2.079	2.116	2.154	2.192	2.229	2.266	2.303	2.340	2.376	2.415	2.452	2.489
84	1.971	2.016	2.053	2.092	2.128	2.166	2.203	2.240	2.277	2.312	2.351	2.389	2.427	2.464	2.502	2.539
96	2.023	2.059	2.097	2.134	2.172	2.210	2.246	2.283	2.321	2.358	2.395	2.433	2.470	2.507	2.546	2.582

TABLE OF CAPACITIES PER MILE OF 5,280 FEET OF WIRE WHEN SUSPENDED IN PARALLEL PAIRS—MICROFARADS.

D	0000	000	00	0	1	2	3	4	5	6	7	8	9	10	11	12
3	0.01741	0.01665	0.01597	0.01533	0.01475	0.01420	0.01369	0.01322	0.01278	0.01238	0.01199	0.01163	0.01129	0.01097	0.01067	0.01038
6	0.01371	0.01324	0.0128	0.01239	0.01200	0.01164	0.01130	0.01097	0.01067	0.01038	0.01011	0.009858	0.009607	0.009378	0.00915	0.008942
9	0.01222	0.01182	0.01147	0.01114	0.01082	0.01052	0.01025	0.00998	0 009736	0.009491	0.009265	0.009044	0.008836	0.008838	0.008451	0.00827
12	0.01130	0.01098	0.01068	0.01039	0.01012	0.009862	0.009614	0.009384	0.009154	0.008948	0.00874	0.008548	0.008362	0.008188	0.008018	0.007851
18	0.01026	0.009988	0.009736	0.009498	0.009268	0.009050	0.008842	0.008646	0.008458	0.00827	0.00810	0.007934	0.007776	0.007623	0 007470	0.007328
24	0.00962	0.009384	0.009160	0 008948	0.008746	0.00855	0.008363	0.008188	0.008018	0.007858	0.007702	0.007552	0.007402	0.007263	0.007130	0.007002
30	0.00918	0.008960	0.008745	0.008565	0.008378	0.008204	0.008032	0.007864	0.007728	0.007558	0.007415	0.007274	0.007136	0 007006	0 006882	0.006764
36	0.00885	0.008648	0.008460	0.008279	0.008104	0.007938	0.007777	0.007622	0.007477	0.007332	0.007199	0.007066	0.006936	0.006815	0.006696	0.006584
48	0.008374	0.008196	0.008020	0.007862	0.007707	0.007550	0.007410	0.007262	0.007130	0.007000	0.006877	0 006758	0.006737	0.006526	0.006419	0.006315
60	0.008034	0.00787	0.007710	0.007564	0.007406	0.007274	0.007143	0.007014	0.006888	0.006764	0.006646	0.006536	0.006427	0.006322	0.006221	0 006120
72	0.007780	0.007623	0.007476	0.007336	0.00720	0.007070	0.006938	0.006815	0.006696	0.006584	0.006475	0.006368	0.006265	0.006162	0.006065	0.00591
84	0.007578	0.007432	0.007292	0.007154	0.00703	0.006898	0.006780	0.006662	0.006550	0.006447	0.006337	0.006231	0.006132	0.006037	0.005941	0 00585
96	0.007410	0.007270	0.007136	0.007008	0.00688	0.006758	0.006642	0.006530	0.006424	0.006319	0.006218	0.006116	0.006020	0.005930	0.005837	0.005749

Experiments on Two-Phased Motors.*

BY LOUIS DUNCAN, S. H. BROWN, W. P. ANDERSON AND S. Q. HAYES.

Within the last few years rotary field motors have been greatly improved, and the conditions for successful design are moderately well understood. The problem has been attacked mathematically, and results have been obtained, which, while interesting, have not been submitted to the test of experiment. The mathematical treatment is difficult, unless many essential phenomena are omitted; indeed, it is only lately that the solution of the case of a motor supplied from a constant potential circuit has been undertaken, and as this is the condition of actual practice, the results, even with their evident limitations, are important and interesting. The phenomena that occur in the armatures of these motors are of special importance, but they have not yet been submitted to experimental investigation.

The experiments of which this article is a description were intended for the purpose of developing a method of obtaining the current and electromotive force curves of multiphase motors, and

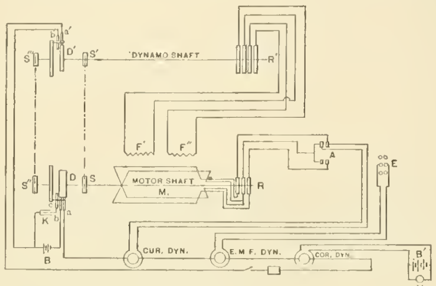


DIAGRAM OF CONNECTIONS

FIG. 1.

of applying it to a two-phase 2-h. p. Tesla motor kindly furnished by the Westinghouse Electric Manufacturing Company. While the results are probably correct for the machine tested, yet as the motor was small, with inward projecting pole pieces, the results will differ considerably from those that would have been obtained on a larger machine, or one without projecting pole pieces. It was impossible for us to get any other machine, and the development of a method is, we think, of as great importance as the results themselves.

In a rotary field motor, if the resultant field is not exactly uniform, but presents some irregularities, then if the difference between the speed of the field and the speed of the armature is not a multiple of both, the armature electromotive force will not in general be a periodic curve, because if we consider an armature coil enclosing a maximum number of lines of induction, then when it again includes the maximum number the field will be in a different position with respect to the poles, and its maximum value may be

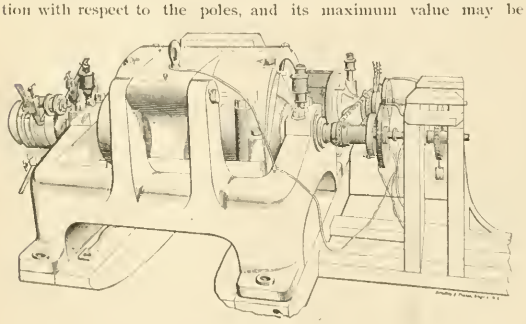


FIG. 2.

different. Or, to put it another way, if the difference of the speeds of the field and armature is not a multiple of both, then any particular armature coil will not have the same relative position with respect to both the field and the pole pieces in its successive positions of maximum induction. It is necessary, then, in order to obtain periodic armature currents, that some form of gearing be employed.

*A paper read at the Philadelphia meeting of the American Institute of Electrical Engineers.

If large machines are to be tested where it would be inconvenient to transmit a large amount of power by gearing, the motor may be loaded until the desired speed of test is approximately attained, when a very light gearing between the dynamo and motor will serve to keep this speed constant, the gearing serving simply to check any small tendency toward a change of speed. In our own experiments, the power to be transmitted was small, and the con-

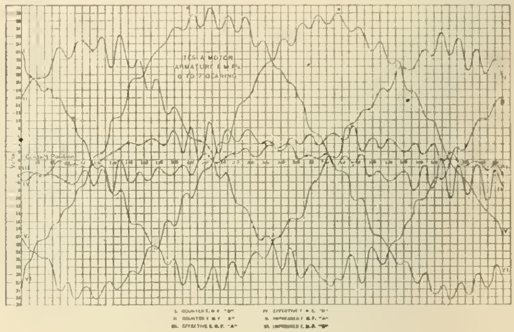


FIG. 3.

struction of the motor was such that we had no room for a gearing and for a coupling to a load. We consequently geared the motor to the dynamo, the motor energy being given back to the dynamo.

The apparatus experimented on consisted of a 25-h. p. two-phased dynamo, an ordinary constant current machine, supplied with four (4) collecting rings, and one (1) two-phase, 8-pole, 2-h. p. Tesla motor. The electromotive force of the dynamo, as may be seen from the curves, was practically a sine curve. In our work the motor was not run up to its full capacity, as we were limited by the amount of power the gearing would safely transmit. We cannot better describe the armature winding of the motor than by quoting part of a letter written me by Mr. Charles F. Scott, of the Westinghouse Company:—

"The one you have, has, however, 41 slots. The odd slot was placed in this motor so that the relation of the armature teeth to the field poles was different in different parts of the circumference,

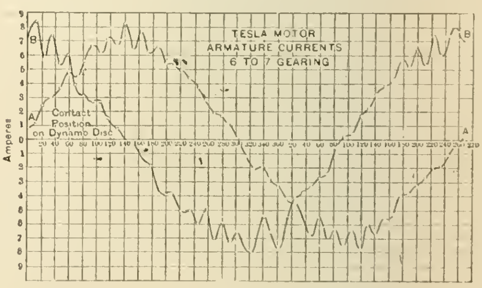


FIG. 4.

and the forty (40) incipient dead points which might have occurred were avoided by the addition of the extra slot. The winding consists of four (4) layers. The first and third are exactly similar and coincident in the slots occupied, and the second and fourth are similarly related. The four coils in each layer are connected in series and short circuited."

The idea was to make the mutual induction of an armature coil, with respect to the poles, a sine curve. Of course, with a limited number of slots it is impossible to have the mutual induction of the field and armature exactly a sine curve. But it is possible to very nearly accomplish this, especially in large armatures, and the importance of it is beginning to be appreciated. Mr. Scott, of the Westinghouse Company, was one of the first to appreciate the importance of the armature winding and the proper method of doing it, and he deserves much credit for his quiet and persistent work, which has resulted in the production of excellent motors, instead of voluminous papers. It is, of course, true that the period of the armature current is the sum of the periods of the field and the armature. As we wished to obtain the curve of the armature cur-

rent by the contact method, it became necessary to get contacts whose period was the sum of the field and armature periods. This was obtained by an arrangement of apparatus shown in Fig. 1. In the figure, S and S′ are the two sprocket wheels which gear the two machines together and give them the desired relative speeds. S″ and S‴ are two others, which gear the graduated discs which carry the brushes. D and D′ are the two instantaneous contact discs, one mounted on each shaft, and a, b, c, a′, b′ are the wiping brushes. K is a condenser, and B a charging battery; b and c make the circuit through the battery and condenser once every revolution, thus keeping the condenser charged. When a and a′ make simultaneous contact, the battery circuit is broken and the condenser is discharged through the movable coils of the dynamometer, which are all connected in series. F and F′ are the motor fields; R and R′ the rings of the motor and dynamo respectively. E is a double-pole, double-throw switch, to which are connected the terminals whose potential difference curves are desired. M is the motor armature, and A is a switch in the circuit of the current instrument. B′ is a battery which sends a steady current through the large coils of a dynamometer. This dynamometer is used as a

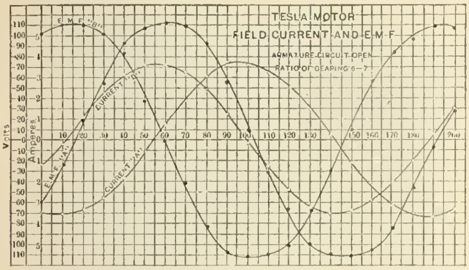


FIG. 5.

correcting instrument, and the resistance in the condenser circuit is regulated to keep its deflection constant. If the brushes are set together on the contacts, and then the two machines revolve with a given speed ratio, say 4 to 3, the brushes will again be simultaneously on the contacts when the machines have made respectively 4 and 3 revolutions. If the ratio was 7 to 6, the machines would make 7 and 6 revolutions before the contacts would again be coincident. In this way we obtained the needed instantaneous current.

After obtaining one point on the curve in this way, and wishing to obtain another point, we must shift our brushes through angular distances proportional to the speed ratio of the two machines; otherwise they would not make simultaneous contact again. Having shifted them in this ratio (say, if the ratio is 6 to 7, we would shift 10 degrees on the dynamo discs, and 6-7th of 10 degrees on the motor disc), we obtain another point on the curve. To accomplish

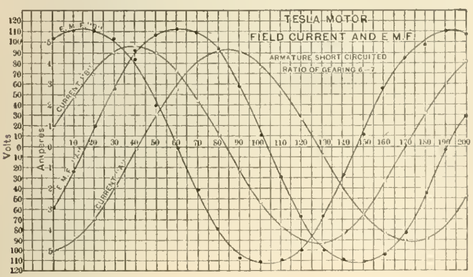


FIG. 6.

this easily, we gear the brushes together in the same ratio as the armatures are geared, as is shown in Fig. 1. Our gearing, both for the brushes and armatures, consisted of sprocket wheels and chains and was very satisfactory.

As the machine we tested was small, and was run much below its rated electromotive force, it was not of course particularly efficient, and as the armature efficiency is approximately the ratio of the armature speed to the field speed, this ratio was comparatively small, thus enabling us to use for measuring it a form of dynamometer which has been described before, and which was invented by one of us for obtaining such curves. It consists of a stationary coil carrying the current whose curves are to be obtained, and a movable coil through which passes an instantaneous direct current, obtained by making the circuit on the armature discs before described. If this instantaneous current occurs when the alternating current is zero, we will get no deflection of the instrument. If it occurs when

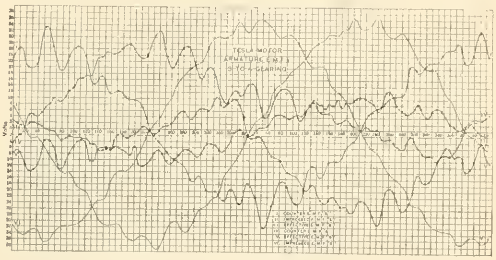


FIG. 7.

the alternating current is maximum, we will get a maximum deflection, and in general the deflection will be proportional to the instantaneous value of the alternating current. The dynamometer used had a long period, and was well dampened, and we had no difficulty in reading, even when the period of the armature current was as much as one-quarter second.

If very efficient machines were to be tested, where the period of the armature is very large indeed, then some electrometer method or a telephone method would be used, or the deflection of a galvanometer needle in the field of the current could be easily photographed.

The curves we have obtained are as follows: The electro-motive force applied to the armature; effective electro-motive force of the armature; the counter electro-motive force of the armature; the armature current; the value of field electro-motive force and current for open and closed armature circuit. These for ratios of 3 to 4 and 6 to 7.

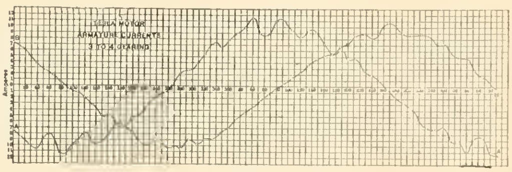


FIG. 8.

We also obtained the various currents and electro-motive forces when the armature was held stationary, with and without resistance in the outside circuit. There are really three distinct sets of curves—those relating to the 3-to-4 gearing, those for the 6-to-7 gearing, and those in which the armature was stationary. The angular positions do not correspond for the first two sets. For the second and third they very nearly correspond. This is due to the fact that we did not at first clearly appreciate the importance of permanently fixing the relative positions of the armatures of the two machines. Afterward we made marks on each armature, and if for any reason we took off the gearing, we replaced it so these marks came opposite points which we fixed on the frames of the two machines. It should also be remarked that the curves for the two sets of armature coils marked A and B should not in general present the same irregularities, as their relative positions, with respect to the poles and the resultant field, are different. The dynamo being a four-pole machine, this must be taken account of in calculating the angles on the base line. In Figs. 3 and 4, the contact positions should be multiplied by two. The length of an armature curve, in terms of the position of the dynamo brush, should be 360×4-2=7,200, in the case of the 3 to 4 gearing, and 360×7-2=12,60 for the 6 to 7 gearing. We have not the same confidence in the results of the 3 to 4 gearing as for the 6 to 7 gearing, the latter being taken from several sets of observations, which checked very well.

The curves of the applied electro-motive force (Curves V and VI, Fig. 3, and II and VI, Fig. 7) are obtained in the following man-

ner: The armature was held stationary, while the field revolved at its normal rate. The reading of our electro-motive force dynamometer then gave us a point on the electro-motive force curve. The armature was then moved through a given angle, while the brush on the dynamo disc was moved through an angle corresponding to the ratio of gearing of the two machines. What we obtained was the electro-motive force applied to the armature when there was no current flowing through it and when the gearing was 3 to 4 or 6 to 7, according to the relative movement we gave the motor armature

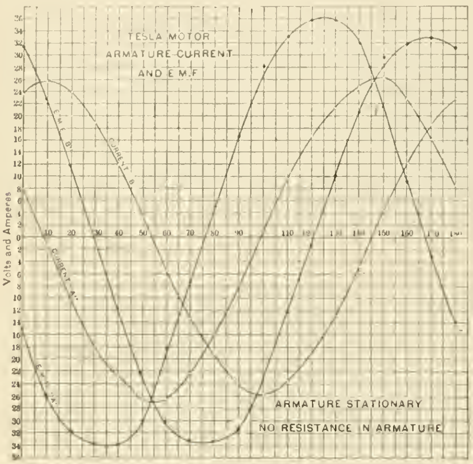


Fig. 10.

and the dynamo brush. It should be remarked that all of the armature curves marked electro-motive force curves are obtained when the armature circuit is open, and therefore do not correspond to the actual condition of affairs when the armature is closed, as they do not contain the effects of armature reaction and self-induction.

The effective electro-motive force of the armature given in Curves III and IV, Fig. 3, and III and IV, Fig. 7, were simply measured by opening the armature circuit and getting the potential difference on the motor terminals when the motor was geared to the dynamo with ratios of 6 to 7 and 3 to 4. The difference between these curves and the curves of impressed electro-motive force is the counter electro-motive force, and is given by Curves I and II, Fig. 3, and I and IV, Fig. 7. We could have obtained the counter electro-motive force by supplying the fields with continuous currents whose ratio to one another would be that of the two-phase currents, and varying the relative values of these currents as we vary the point of contact of our instantaneous current. This would have been a laborious task, and was not necessary. It was not possible

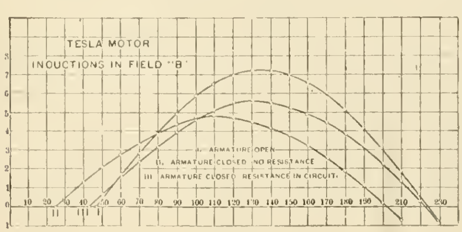


Fig. 11.

to obtain these quantities by direct observation when the armature circuit was closed and when the machine was running under normal conditions.

In Fig. 4 is given the armature current of the motor with a gearing of 6 to 7. If we compare these curves with those obtained when the gearing is 3 to 4, we will see that the current is more irregular with the higher efficiency than with the lower. Again, comparing the curves of effective electro-motive force for the two gearings, we see again that the irregularity is greater with the higher efficiency. If we consider that the current would follow this curve of effective electro-motive force, but for the armature reactions and self-induction, we can see that these effects have their good as well as evil side. The effective electro-motive force is of course the difference between the applied and the counter electro-motive forces, and if these are irregular their difference becomes the more irregular as they are the more equal in value, that is, as the efficiency of the motor is higher. So that, while in this machine, whose maximum armature efficiency was made about 87 per cent., the irregularity is considerable, it would be very much exaggerated in a larger motor whose armature efficiency might be 97 per cent. or 98 per cent.; and in this case great care should be taken to produce a perfectly regular field. The effect of the armature reaction and self-induction is to decrease these irregularities.

If we consider for a moment the theory of the two-phased motor, we will remember that the armature efficiency is theoretically (leaving out losses in the field iron) $p : p_1$ where p and p^1 are respectively the angular velocities of the field and of the motor armature. We will also remember that the lag of the armature current behind the effective electro-motive force is taken as $\tan \theta = \frac{(p - p') L.}{r}$ If we look at the curves, however, obtained with the motor experimented on, we will see that the armature current is irregular, and therefore the actual heating would be greater than that calculated from sine curves—that is, the armature efficiency is always less and the drop in speed is always greater than the theoretical value, and may be very much less if the armature current is irregular. As has

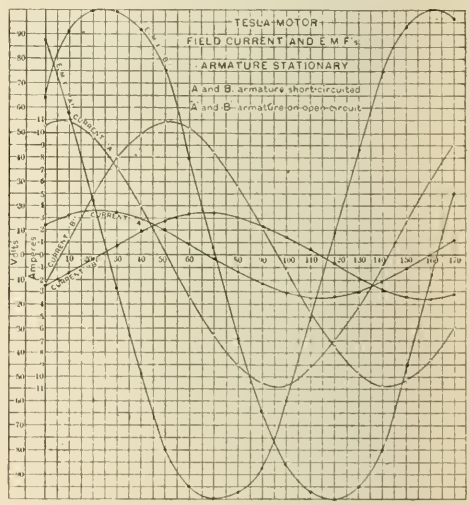


Fig. 9.

been pointed out, this fluctuation in the armature current would be exceedingly great if the self-induction and armature reaction of the motor did not tend to wipe it out, the effect of the self-induction being to damp the most the waves of shorter period—that is, the irregularities.

It seems to us that the most important curves we have obtained are those of applied and counter electro-motive forces, effective electro-motive force, and the armature current. They show at once the great importance of designing a machine whose applied and counter electro-motive forces are both sine curves, and the method may be easily used to experiment on actual machines and to find out if this condition is fulfilled. Again, the comparison of the effective electro-motive forces, with no armature current, with the fall of potential due to the armature current, shows us that there is some beneficial effect from self-induction in the armature. The principal results show that the special machine does not give us regular currents and electro-motive forces, but it is to a large extent due to the fact that in these small machines considerations of economy make it necessary to wind the field coils on spools, instead of winding them through slots cut in the field iron.

In designing a motor to give absolutely regular electro-motive force curves, we must take two things into account: The field due to the dynamo current must be regular, and the armature winding

must be such that it will give a regular electro-motive force in a regular field. To satisfy this condition in the field windings, projecting pole pieces should certainly be avoided. To satisfy the condition in the armature would require an infinite number of armature windings, but it can be practically satisfied in the higher machines with a reasonable number of windings. It must not be understood that it is specially easy to accomplish this. Figs. 5 and 6 give us the input of the motor at full load and with an open armature, with a 6 to 7 gearing. Figs. 9 and 10 show the field and armature electro-motive forces and currents when the armature is stationary, and in one case short circuited, and in the other case has outside resistances in its circuit. Fig. 11 gives in arbitrary units the induction through a coil wound around one of the pole pieces, under the conditions stated.

We do not wish to add to an already lengthy paper a prolonged discussion of the curves we have given, especially as we hope to be able to experiment on a larger machine, the results from which will be of much greater importance; but we think that the curves we have given show that the design of rotary field motors requires careful experimental study, and we believe that such a study may be easily made, even for machines of large capacity.

Practical Notes on Dynamo Calculations.—VIII.

BY ALFRED E. WIENER.

d.—Total Energy Loss in Armature.

The total energy transformed into heat in the armature is the sum of the energies consumed by the winding, by hysteresis, and by eddy currents:

$$W_a = w_a + w_h + w_e \qquad (42)$$

W_a = total watts absorbed in armature;
w_a = watts consumed by armature winding, formula (35);
w_h = watts consumed by hysteresis, formula (39);
w_e = watts consumed by eddy currents, formula (41).

For comparison, in the following Table XXVIII., the energy losses due to hysteresis and eddy currents, expressed in various units of the metric as well as the English system, are compiled:

TABLE XXVIII.—SPECIFIC ENERGY DISSIPATION IN ARMATURE CORE.

Magnetic Density.		Hysteresis loss for sheet iron at frequency of 1 magnetic cycle per sec.				Eddy current loss for .030″ (.075 cm.) lamination, at 1 cycle per second, proportional to frequency.			
Gausses.	Lines of Force. Per sq. inch.	Per cm³	Per cu. ft.	Per kg.	Per lb.	Per cm³	Per cu. ft.	Per kg.	Per lb.
		Watts.	Watts.	Watts.	Watts.	Watts.	Watts.	Watts.	Watts.
2000	12900	.00007	1.98	.0091	.0041	.0000004	.011	.000051	.000023
3000	19350	.00013	3.68	.0140	.0077	.0000009	.026	.000119	.000054
4000	25800	.00020	5.75	.0265	.0120	.0000016	.046	.000212	.000096
5000	32250	.00029	8.20	.0378	.0171	.0000025	.071	.000327	.000148
6000	38700	.00039	11.03	.0508	.0230	.0000036	.102	.000471	.000213
7000	45150	.00050	14.15	.0652	.0295	.0000049	.139	.000640	.000290
8000	51600	.00062	17.5	.0806	.0365	.0000064	.181	.000833	.000377
9000	58050	.00074	20.9	.0963	.0436	.0000081	.229	.001054	.000478
10000	64500	.00087	24.6	.1133	.0513	.0000100	.283	.001303	.000590
11000	70950	.00102	28.3	.1303	.0590	.0000121	.343	.001580	.000715
12000	77400	.00118	33.1	.1524	.0690	.0000144	.408	.001878	.000850
13000	83850	.00134	37.9	.1745	.0790	.0000169	.479	.002204	.000998
14000	90300	.00150	42.7	.1966	.0890	.0000196	.555	.002553	.001157
15000	96750	.00168	47.5	.2193	.0990	.0000225	.637	.002923	.001328
16000	103200	.00187	52.9	.2440	.1103	.0000256	.725	.003340	.001512
17000	109650	.00206	58.3	.2680	.1212	.0000289	.818	.003770	.001708
18000	116100	.00225	63.7	.2932	.1328	.0000324	.917	.004220	.001911
19000	122550	.00246	69.6	.3200	.1450	.0000361	1.022	.004710	.0021.0
20000	129000	.00267	75.6	.3480	.1575	.0000400	1.133	.005225	.002362

17.—Radiating Surface of Armature.

The radiating surface, or cooling surface, of an armature is that portion of its superficial area which is in direct contact with the

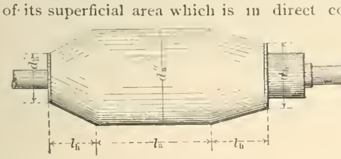


FIG. 17.

surrounding air, and which consequently gives off the heat generated in the winding and in the iron core. It is evident that the shape and the construction of the armature and the arrangement of the field determine the size of this radiating portion of the armature surface. In drum armatures, for instance, only the external surface is liberating heat, while in ring armatures, according to design, either the external surface only or any two or three sides of the cross section, or even the entire superficial area may act as cooling surface.

a.—Radiating Surface of Drum Armatures.

In drum armatures the dead portion of the winding forms two "*heads*" at the ends of the cylindrical body, and the external area, extending over the cylindrical part, as well as over these two conical heads, is the radiating surface of the armature. In order to calculate the cooling area of a drum armature, it is therefore necessary to first determine the size of the armature heads.

The length of the heads, l_h, Fig. 17, depends upon the diameter of the armature, the size of the shaft and the height of the winding space, and can be found from the empirical formula:

$$l_h = k_7 \times d''_a + 2 \times h_a. \qquad (43)$$

where: l_h = length of armature heads, in inches;
k_7 = constant, depending upon the size of the armature (see Table XXIX.);
d''_a = external diameter of armature, in inches;
h_a = height of winding space, in inches.

The coefficient k_7 in this formula varies with the slope of the head, and this, in turn, depends upon the ratio between the diameter of the armature and the thickness of the shaft. For in large

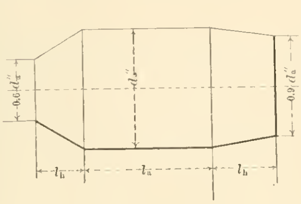


FIG. 18.

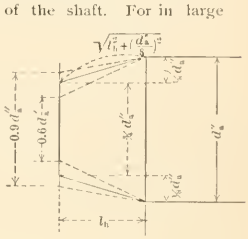


FIG. 19.

machines the shaft bears a smaller proportion to the armature diameter than in small ones, and therefore in large armatures there is comparatively much more room between the shaft circumference and the body periphery than in small armatures, and since the diameter of the head must never exceed that of the armature itself, it is evident that the slope of the head is smaller, and consequently its relative length is larger in the smaller armatures. The following Table XXIX. gives the values of this coefficient for the various sizes of drum armatures:

TABLE XXIX. LENGTH OF HEADS IN DRUM ARMATURES.

External Diameter of Armature. d''_a	Value of k_7	Average Length of heads. l_h Inches.
Up to 6″	.60 to .50	$l_h = .55 \times d''_a + 2 h_a$
" " 12″	.55 to .45	$= .50 \times d''_a + 2 h_a$
" " 18″	.50 to .40	$= .45 \times d''_a + 2 h_a$
" " 24″	.45 to .35	$= .40 \times d''_a + 2 h_a$
" " 30″	.40 to .30	$= .35 \times d''_a + 2 h_a$

As to the diameters at the ends of the heads, that of the front head, d_h, at commutator end of armature, is generally made from 0.75 d''_a to d''_a, while the diameter of the end washer of the back head, d_h, ranges in size from 0.5 d''_a to 0.75 d''_a. Taking $d_h = 0.9\ d''_a$ as the average diameter of the front head, and $d'_h = 0.6\ d''_a$ as that of the back head (Figs. 18 and 19) we obtain the following formula for the radiating surface of a drum armature:

$$O_a = d''_a \times \pi \times \left(l_a + 1\tfrac{3}{4} \times \sqrt{l_h^2 + \left(\frac{d_a''}{8}\right)^2} \right),$$

or, approximately:—

$$O_a = d''_a \times \pi \times \left(l_a + 1.8 \times l_h \right) \qquad (44)$$

O_a = radiating surface of armature, in square inches;
d''_a = external diameter of armature, in inches;
$= d_a + 2 \times h_a$;
l_a = length of armature body, in inches, formula (12);
l_h = length of armature head, in inches, from formula (43).

(To be continued.)

An English Electrical Invention.

A recent English patent has the following title: "Improvements in Portland cement in union with petroleum; for the incandescence of electric gases; in man's, animals' and birds' excrescences in air, land and water."

The Electrical World's Digest of Current Technical Electrical Literature

Compiled from Principal Foreign Electrical Journals by Carl Hering

ELEC WORLD, N.Y.

ELECTRO-PHYSICS.

Work of Hertz.—The lecture of Prof. Lodge is continued in the Lond. "Elec.," June 15; a number of interesting experiments are described, and illustrations given. It is written in a rather abbreviated style, and assumes a knowledge of the subject.

Detector of Electric Waves.—In an editorial on Prof. Lodge's lecture, the Lond. "Elec. Rev.," June 15, describes an instrument (illustrated in the Lond. "Elec.," June 15), which he has devised, which is called a coherer; two knobs so close together that the air gap is not able to stand any such voltage as an electroscope can show, will actually cohere when a spark passes between them, and the joint thus completed closes the circuit of an electric bell and battery. On this phenomena he founded a theory of vision, in which the retina of the eye is supposed to be furnished with cohesive contents which allow an electric current to flow in the nerves when acted upon by the electro-magnetic waves of light; mechanical vibration supplied by the tissues restores the sensitiveness of the contact at intervals of a tenth of a second; a model was constructed to illustrate the theory.

Theory of Vision.—See abstract under "Detector of Electric Waves."

UNITS, MEASUREMENTS AND INSTRUMENTS.

Specific Conductivity.—A paper by Mr. Teichmueller, read before the Union of German Electrical Engineers, is published in full in the "Elek. Zeit.," June 9. He discusses the three different ways in which specific conductivity is given, namely by reference to pure copper considered as 100 per cent., by reference to mercury and by representing it in mhos per unit length and cross-section and concludes in favor of the latter; although this method was the one used least, he believes it was due to the want of a name of the unit, which has now been supplied; he concludes in favor of expressing conductivities in mhos and specific conductivites in megamhocentimeters; the number for copper will have values of about 0.58 and 0.595; these values are based on the absolute system but depend on the value of the ohm. The arguments in the article are contained more at length in an article by the same author abstracted in the Digest April 28. He recommends that the society take action by appointing a committee to consider and report on the subject.

Galvanometer.—A paper by Messrs. du Bois & Rubens, describing some new forms of sensitive galvanometers, is published in the "Elek. Zeit.," June 9, including several illustrations and a table of constants.

Photometry.—An article by Mr. Henry on the pupil and photometry is begun in "La Lum. Elec.," June 9, the present portion being devoted to the pupil and its measurements.

Brillie Meter.—A well illustrated description of the improved form of this meter, which is one of the principal meters used in France, is given in "La Lum. Elec.," June 9.

DYNAMOS AND MOTORS.

Current Curves of Alternators.—A paper by Messrs. Roessler & Wedding, read before the Union of German Electrical Engineers, is published in full, together with numerous curves, tables and illustrations in the "Elek. Zeit.," June 9. The object of the paper is to show the influence of the shape of the curves on the candle-power of alternating arc lamps; the second part of the paper, which is devoted to arc lights, is abstracted below under "arc lights." Three machines were tested, the curve of the alternating current being measured by the usual method of making momentary connection between a fixed brush and a movable contact piece which may be placed in any position with respect to the field. The method used is described in detail. Three machines were used, a four-pole Ganz, the armature of which consisted of four radial magnets terminating opposite the pole pieces; a Wechsler, consisting of a sort of a Gramme ring winding, the ring revolving between opposite poles of four pairs of magnets; the third, a machine of Siemens & Halske, in which the armature and field magnet coils were all radial. The results for the Ganz machine showed a very abrupt increase in the voltage, followed by an almost equally abrupt, and an apparently long period of practically no voltage, the latter forming about two-thirds of the whole wave. In the Siemens machine the increase is gradual, the voltage remaining nearly constant for about half the period, and then falls again, including a slight rise just before falling; for the Wechsler machine the curves were between the others and corresponded very closely with a sine curve. A number of conclusions are drawn from these, among which it is claimed that the large air-gap in the Wechsler machine is that to which the approximate sine curve is due, there being no abrupt changes as in the others, and it is concluded that a large air-gap is a very good feature when a sine curve is desired; the flat part of the curve of the Siemens & Halske is due to the very large pole piece, in which it differs from the Ganz machine. Another conclusion is that with alternating current arc lamps, electromotive forces of a different phase than that of the acting voltage do not arise.

Unipolar Dynamos.—The Lond. "Elec. Rev.," June 15, contains an editorial on non-polar dynamos in America, presumably criticising the recent institute paper of Prof. Crocker and Mr. Parnley, in which, however, the main features of the paper are not considered; it is claimed that the suggested designs will be found to be old, and to have been often proposed. Foucault currents are said to exist without doubt, because the armatures of such machines get warm on open circuits; armature reaction takes place to a great extent, as is claimed to have been proven some time ago by direct experiment. It is claimed that the efficiency of the non polar dynamo and storage battery transformer combination could not possibly be higher than 60 per cent.

ARC AND INCANDESCENT LIGHTS.

Alternating Current Arc Lamps.—A paper by Messrs. Roessler & Wedding, read before the Union of German Electrical Engineers, is published in full in the "Elek. Zeit.," June 9. The first part of the paper treats with the curves of different alternators, and is abstracted under "Dynamos and Motors." The second portion treats of the arc lamp. The influence of the character of the current curves on the regulation of the lamps is discussed; a differential lamp was used, with both shunt and series coils; it was found that the regulation had to be altered very considerably when the lamp was used with three different machines described in the first part of the article, and when continuous currents were used it was not possible to effect a regulation, as the pull and the heating of the coils then became too great. The shunt coil affects the regulation for different curves of current by virtue of its self-induction, and because the pull exerted by these currents will be different, which latter will also be the case with the series coils; it is concluded that if an arc lamp is to be adapted for a number of different machines it is better to use the iron of the coils at as low a saturation as possible. The photometric tests are described in detail, the results being given in tables and curves; the lamp was in each case adjusted so that it would burn with the greatest constancy, when it was found that the maximum variation of the voltage was less than 0.3 volts; the voltages used were between 28.8 and 31.1; the lamps were measured with a white reflector, and the light was measured only below the horizontal plane. When run with the Ganz machine the mean spherical candle-power per watt, below the horizontal, was 0.716; with the Wechsler machine it was 1.03, and with the Siemens & Halske, 1.078; owing to the sudden change in the curves of the Ganz machine the energy was not so well utilized to produce light; by virtue of the gradually changing sine curve the increase in the light for the Wechsler machine was about 44 per cent. or for the same current, voltage and light, three lamps would have to be used with the Ganz machine, and only two with the Wechsler. With the Siemens & Halske an increase of 6 per cent. in the light was obtained, with an increase of 33 per cent. in the frequency. The ratio of the simple mean of the current to the square-root of the mean square is 0.656 with the Ganz machine, 0.907 for the Wechsler, and 0.911 for the Siemens & Halske. For a true sine

curve it would be 0.900; the difference between the first two is about 28 per cent., while the photometric measurements show a difference of 30 per cent., from which it is concluded that the generation of light in the ordinary alternating current arc depends on the mean value of the current as distinguished from the square-root of the mean of the squares. The above ratio will be unity when the curve consists of two rectangles, one above and the other below the line, for which the development of light would then be a maximum, which curve is approached by the Siemens machine; but there are objections to designing machines with such curves; a very loud and disagreeable noise accompanied the running of the lamps with the Ganz machine, while with the Siemens machine this noise ceased, but the humming of the alternating current became greater; but with the Wechsler machine the lamps burned silently. Taking this noise into account, it is concluded that the best ideal is a true sine curve. In conclusion they show that the energy in a continuous current lamp is much greater than in an alternating current lamp for the same current strength. In the former 2.84 mean spherical c. p. were obtained per watt, which was partly due to a very thin carbon, and partly to a greater consumption of energy; with about the same consumption of energy this figure was 2.65, showing that the efficiency in a continuous current lamp is very materially higher; part of the difference is due to the 30 per cent. loss in the reflector. With two continuous current lamps in series on 110 volt mains, 1,528 c. p. were obtained, while with 4 alternating current lamps in series on 110 volts, consuming about the same energy, 1,175 c. p. were obtained, showing that even under these conditions the continuous current arc is the more efficient.

Multiple Filament Lamps.—According to a statement in the Lond. "Elec.," June 15, experiments with these lamps are said to have shown that there is practically no afterglow when the current is shut off, as there is with single filament lamps, and that the English Admiralty have therefore directed that the multiple filament lamp be adopted for mast head flashing lanterns on all the higher class ships.

Life and Efficiency Tests of Incandescent Lamps.—A translation of the article abstracted in the Digest June 9, is published in the Lond. "Elec. Rev.," June 15, giving also the table of results.

ELECTRIC RAILWAYS.

Accumulator Traction.—According to a correspondent in the Lond. "Elec. Rev.," June 15, one ton of batteries of the Theryc-Oblasser type, in a certain trial test ran a car 46.5 miles at 7½ to 9⅓ miles per hour.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Electrical Engineering in England.—A paper by Mr. Kapp, read before the Union of German Electrical Engineers, is published in full in the "Elek. Zeit.," June 5. After discussing the history, the early development and the different conditions in that country and elsewhere, he gives, among others, the following figures. At the present time the number of lamps operated with alternating current, as compared with continuous current, is as 4 to 5; as a mean of 18 continuous current stations he finds that every kilowatt-hour sold per year represents an investment of capital in the installation of about $1.12; a mean for ten alternating current stations gives $1.30; these figures were for the past year, but the stations are not fully loaded; making a correction for an increased number of lamps without increasing the machinery, the figures will be 0.72 and 1.10 respectively; the greater cost of the alternating current station is due to the fact that the distances of the transmission are greater; these figures include all the costs, but for new stations constructed at the present time, and assuming the complete output of lamps, he estimates that the following figures are fair means; for continuous currents $0.62 for the first part of the installation, and $0.50 when the station is completed, and for alternating currents, $0.88 and $0.62 respectively. For an equal amount of light the capital required in the largest gas works is about one-third as great, while for small gas works it is about equal to that for an electrical installation. The average time of lighting of the lamps in the last year was 480 hours. On the basis of 50 watts per lamp there were, during the past year, 825,250 lamps connected to 84 stations, the total power of which was 74,700 indicated h. p.; out of these 467,000 are in England; to light London completely with electric lamps would require from 4 to 5 million lamps, therefore the lighting at present is one-tenth of this. The total capital invested is about 30 million dollars, not including four million invested in the Deptford station; the cost of municipal works per lamp is smaller than that for private companies' plants. The average price charged for the current is about 12 cts. per kilowatt hour, and the average receipt per 50 watt lamp installed per year, is $2.50 to $3. Electricity for electro-chemical purposes is not used much in England; transmissions of power for longer distances is not common, but the application for coal cutting machinery is quite common. He states that, strange to say, the multiphase system is not meeting with favor in England, and many of the companies will have nothing to do with it.

Power Distribution.—In the concluding part of Mr. De Segundo's article, in the Lond. "Elec. Eng.," June 15, he discusses, among other things, the Van Rysselberghe system, to be used in Antwerp (in which power is distributed hydraulically and transformed into electrical energy at small distribution centers), some figures are given, and it is stated that there is no doubt that power can be produced and delivered hydraulically at a smaller cost than electrically, and that the reason is that a more efficient engine can generally be used, and it can be worked more efficiently, as it always works at full load to full stroke, and there is also a much greater efficiency in distribution through pipes. In discussing gas engines he dwells at some length on a combination of electric light and gas interests, which he thinks would solve the problem of electric supply in many cities. He recommends using the gas works as an already constructed power station, and establishing distribution stations at suitable points in the town, where the electric currents are generated by means of gas engines. The following figures are given, taken from the weekly records of a plant at Bradford supplying 300 lamps; the total cost per kilowatt-hour is 4 cts., the price of the gas being about 80 cts. per 1000 cb. ft.; allowing 5 per cent. for loss in mains, and 0.6 cts. per kilowatt-hour for depreciation in plant and buildings, it brings the cost up to 4.8 cts., adding a liberal allowance of 1.2 cts. per kilowatt-hour for management expenses, the total cost will be 6 cts. per kilowatt-hour delivered, which is a lower figure than that usually realized in practice by any purely electric supply company working under those conditions. He discusses the light efficiency of gas burned in a burner, which, according to Prof. Tyndall, is 0.317 per cent., and shows that when used in a gas engine and dynamo, the efficiency is increased 2.5 times, notwithstanding the three-fold transformation. He believes that in a system such as that proposed the cost of maintenance, superintendence and management will be less than under conditons of independent electric suppiy.

Three-Wire System with a Single Dynamo.—A paper by Mr. von Dolivo Dobrowolski is published in full with illustrations in the "Elek. Zeit.," June 9. He describes his ingenious device (described and illustrated in the Digest, Feb. 3, and referred to May 12), in which the neutral wire is connected to the armature through self-induction coils. In addition to what was given in that abstract, he states that such machines can also be used as motors, and, therefore, as equalizers, in which capacity they may be used to advantage in installations in which it is desired to omit the neutral wire for the more distant districts. The neutral wire of this district is extended only to this motor; with the circuits unequally loaded one-half of the armature acts as a motor and the other as a dynamo. Such a machine will operate only when the difference between the two circuits is not too great in proportion to the output of the dynamo. If the loss of voltage in the dynamo at full load is 4 per cent. the voltages in the halves, when the difference between the two loads is 10 per cent., will be only 0.4 per cent. different from the mean, besides 0.5 per cent. additional in the self-induction coils. It is not possible in this system to increase the voltage on one side, as is possible with two dynamos, but the same result can be accomplished by inserting resistances in the main line to absorb a few volts; or it can be accomplished by inserting a small dynamo in the neutral wire, which will regulate both sides. It need regulate for only half of the difference of potential, and will be sufficient to proportion its wires to carry one-tenth of the current in the outside circuit.

Three-Wire System.—The article by Mr. Claude, abstracted in the Digest June 23, under "Advantages of Constant Voltage," is concluded in "La Lum. Elec.," June 9. He discusses the disadvantages inherent in the three-wire system, concluding that in any case the regulation for constant voltage cannot be accomplished as perfectly as in the simple system. He shows that in case the drop in volts in the neutral wire for the extreme lamp is greater than the loss in one of the outside wires, the apparently paradoxical result may be that the voltage is higher at the extremity of the line than at its origin. He cites another case in which some arc lamps were run between the outside mains, and in which the voltage in one of the circuits suddenly fell to zero, and after a few minutes rose again to its normal value; it was found that one of the brushes of one of the machines did not touch the commutator, which was the cause of the trouble; the total charge had thereby been thrown on the other dynamo, increasing its output to a point beyond the characteristic, thus reducing the voltage to zero, and the arc lights had then only 100 volts, which was not sufficient to start the arcs, but they formed a connection between the outside wires which reversed the faulty dynamo, after which the dynamos were running simply in multiple arc. He calculates that the actual cost of the wire for the two-wire system at 100 volts, is only 25 to 30 per cent. higher than that for three wires, and as the cost of the wires is only about one-fourth of the total cost of the installation, this increase corresponds to only 7 per cent. increase in the total; this, though small, is often considered sufficient to justify the adoption of the three-wire system, notwithstanding the poorer regulation. He suggests using a simple two-wire system at 200 volts, and connecting two lamps in series, believing that the regularity in the voltage will then enable the lamps to be run more brilliant and more economical; also that the output of a station will then probably increase rapidly, as it enables a reduction in the selling price to be made. Such a system is particularly applicable to the alternating current, in which a small self-induction coil can be arranged to be cut into the circuit to replace one of the two lamps in series.

WIRES, WIRING AND CONDUITS.

Safety Fuses.—A paper by Mr. Feldmann, read before the Union of German Electrical Engineers, is published in full in the "Elek Zeit.," June 9. Regarding the safety factor in fuses he states that in America, a factor of 2 is usual, but that it should be different for different kinds of circuits; for overhead wires, for instance, it could very well be 2.5, and even 3, but for underground cables it is much too high for alternating currents, when the current is used for electro-mag-

netic purposes, the fuses should be calculated, not for the working current, but for the total current, including the working and the wattless current, which, in some cases, may be very great; when used only for inductionless apparatus a factor of 2 can be used for secondary circuits, and 2.5 for the primary, it being preferable to have the secondary fuse blow first; when several transformers are used for several consumers, the possibility of short circuits is greater, and he suggests 2.5 for the secondary, and 3 for the primary. When there are a number of large transformers supplying mains in common, the factors should be taken still larger, depending on the equality of the voltage of the different transformers; the same is true of fuses for dynamos in parallel. Regarding the size of the fuses, he states that the minimum fusing current is proportional to the 3-2 power of the diameter and inversely proportional to the 4th root of the length, and that the size of the radiating surfaces of the clamps affect the fusing current very greatly; in two cases the surfaces, were as 1 to 5, and the fusing currents for otherwise identical conditions were as 1 to 1.35; when one of two like fuses was cooled to 10° C, and another heated to 60° C, the currents were as 1.1 to 1, showing the influence of external temperature. Lead is most unsuitable for such fuses as it oxidizes, the oxides forming an infusible tube. Mr. Preece recommends platinum, which melts like wax, while tin and copper melt with an explosive action; the most common alloy is lead and tin with or without bismuth and antimony; iron is quite unsuitable; he recommends highly the Schuckert fuses, made of a band cut into a number of thin strips connected at their ends and bent apart so as to allow access of the air; also the Cockburn fuses of tin, with 5 per cent. of phosphor, and a weight suspended from the middle part. These are said to differ in their fusing currents only by 5 to 10 per cent. They are especially to be recommended for small currents, as the wire may be taken slightly larger. The weak point of fuses lies in the poor contacts. Prof. Heim found that the loss of volts due to these contacts varied from 0.06 to 0.4 volts, and for poor contacts these might be much greater. In conclusion he recommends that the Society adopt the uniform practice of marking fuses with their fusing current, and not with a safe carrying current, because the latter differs for different conditions.

Calculation of Mains.—An article by Mr. Frick on a simplified method for calculating the distribution of current in networks of conductors, is begun in the "Zeit. fuer Elek.," May 15. The article does not admit of being abstracted; a table is given serving as a guide for preliminary determinations; it gives the relation between the cross-section of the wire, the load in amperes per metre, considered as being uniform, and the resulting allowable distance between the feeding points for the three-wire system and a maximum loss of 3 volts; the formula for the calculation of this table is given; having made preliminary determinations with the aid of this table, the distribution of the current through the network for a given amount of current may then be determined; he mentions four methods of doing this, one involving equations, which is too complicated, another by means of graphical calculations, another by mechanical devices, and another—presumably his own—which is discussed more in detail; if the distribution of the current thus determined involves more than the maximum allowable loss, the various cross-sections must be modified; the problem is simplified by assuming the potential at the feeding points to be everywhere equal and constant.

Wire Computing.—A correspondent in the Lond. "Elec. Rev.," June 12, recommends the following method as being a quick solution of certain problems.. A table is calculated, giving the cross-sectional area of copper wire for every number of yards per ohm from one to nine; if, for instance, the cross-section of a conductor is required, such that a given number of yards has a certain resistance, dividing the former by the latter gives the number of yards per ohm; if, for instance, this was 526, the cross-sectional area taken from that table for 500 (100 times that for 5) is added to that for 20 (10 times that for 2), and to that for 6, the sum will give the total cross-sectional area. It is suggested that this method of tabulating constants might be extended to other electrical calculations.

ELECTRO-CHEMISTRY.

*Note: Owing to the crowded condition of these columns, articles and notes belonging more properly to the department of Chemistry than to the department of Electricity will hereafter not be introduced in the Digest, unless they are of special interest.**

Waterhouse Electrolytic Meter.—The English journals for June 15 contain an illustrated description of this new and interesting meter; the best description, with the largest number of illustrations, is given in the Lond. "Elec. Rev.," in which the meter is spoken of as "the best of its class yet brought to our notice; . . . . . the curves made out by the inventors are wonderfully straight, and show extreme accuracy throughout the whole range of the meter;" the description in the Lond. "Elec. " is rather brief. A description of the apparatus will be found elsewhere in these columns.

Hermite Process. A report from the medical journal, "Lancet," is published in part in the Lond. "Elec. Eng.," June 1. Among other things it is stated that the liquid deodorizes but does not destroy organic matter; ordinary paper rapidly reduces the strength of the solution, as does also other materials in the sewers; deodorization is complete only when the chlorinated body is in excess, but in that case it is not admissible to discharge it into rivers; it is stated that the adoption of the Hermite process in towns would no doubt lead to a sanitary condition of things hitherto unreached, but that the cost is excessive; the antiseptic value may be estimated in terms of the available chlorine or oxidizing power, and that, therefore, a solution of bleaching powder of equivalent strength might be substituted for it, and might be much less expensive. The Hermite solution, as an antiseptic, is much more efficient than carbonic acid, even in more dilute solutions, the only other substance which is better, in the latter respect, being corrosive sublimate; the solution seems to be used up and destroyed to a much less extent by organic matter than any other disinfectants which were known to the experimenters; between 0.50 and 0.60 gram of chlorine per litre is all that is considered necessary for sewage treatment.

The report of Dr. Ruffer is summarized in "Ind. and Iron," June 11. The conclusions are that solutions containing less than 0.75 gram per litre are useless for the sterilization of sewage; but with such a solution the sewage can be made quite sterile, provided the solution is intimately mixed; also that the deodorization is immediate. With 250 amperes at six volts, it took 90 to 100 minutes to develop 0.5 gram per litre in a quantity of 750 litres. He finds that in a 0.5 gram solution the amount of chlorine diminished 90 per cent. in 24 hours' standing, but in solutions of 0.75 the loss was only 34 per cent.; when the current is increased 100 per cent. the increase in the yield of the chlorine is only 50 per cent., thus increasing the cost considerably. Experiments are described, showing that in certain cases sterilization was complete, but the action of the air on the liquid after sterilization again contaminates it; the bacillus subtilis seems to be the most resisting. No general conclusions are drawn, except those given above, and the fact that it is essential to disintegrate the sewage and make a thorough mixture with the solution.

The Lond. "Elec. Rev.," June 8, quotes in part the report from the "Lancet," giving, however, some other parts of it; it is claimed in that report that the magnesium compounds play the most important part, which statement is criticised in this journal, and figures are given tending to prove that the sodium chloride plays more than the part of a conductor.

New Accumulator.—Mr. Tauleigne in "Cosmos," June 2, describes an accumulator, the negative electrode of which is formed of carbon in a porous cup, surrounded with chloride of lead firmly packed around it; the positive electrode surrounding the porous cup is also made of carbon, and the electrolyte is a 60 per cent. solution of protochloride of iron; in this condition it is ready to receive a charge; the E. M. F. is 1.40 volts, the capacity per pound of "metal" (as there is no metal, probably the carbon is meant) is 71 ampere hours; the energy stored per pound of "metal" is 75-foot pound hours; a horse-power hour is said to be obtained with about 7.3 pounds of "metal;" he claims to have obtained 23 ampere hours per pound of active material; no gas is disengaged at charging.

Electrolysis.—An article on this subject, elementary in character, is published in the Lond. 'Elec.," June 15, by Mr. Waddell; some interesting analogies are given.

Electrolytic Gold Leaf.—Mr. Swan, before the Royal Society of London, exhibited several specimens of electro-deposited gold leaf four millionths of an inch thick; the gold is deposited on a thin, highly polished electro-deposited sheet of copper, which is then dissolved off with per chloride of iron; it reflects like a yellow mirror, and is perfectly transparent, transmitting a greenish light.

Electrolytic Iron.—According to the Lond. "Elec. Rev.," June 15, Mr. Lockyer finds from the spectrum of electrolytic iron that it contains calcium and manganese, as well as traces of other metals.

MISCELLANEOUS.

Retort Carbons.—In a report to the German Gas Society, Mr. Hempel calls attention to the high price of large retort carbons as used in electrolytic processes, and suggests that it might be possible to manufacture such plates in the retorts themselves, by supplying smooth flat surfaces on which the carbon is deposited; it might be possible to introduce the contact wires in the plates during the process of their formation.

Death by Electricity Dr. d' Arsonval, in a communication to the Paris Academy of Sciences, states that death from the electric current is like that in drowning, and is often only apparent; in such cases the treatment should, therefore, be like in cases of drowning; he believes that the criminals executed electrically in New York are really alive, and die only in the absence of restoratives. He cites the case of a workman in St. Denis who was subjected to 4,500 volts, and was restored to consciousness in a short time, although he had been left three-quarters of an hour under the supposition that he was dead. He was restored by artificial respiration.

Bacteriology. According to a note in "Cosmos," June 2, Prof. Ward, in a Royal Institute paper, shows that light rays and not heat rays are what kill bacteria; also that among the different colored rays the blue are the most effective.

Saturn's Rings.—A note in "La Nature," May 19, discusses the possibility of the maintenance of these rings by the magnetic action of that planet, supposing that the rings are composed partly of a dia-magnetic substance; it is thought possible that the magnetic field of that planet is 100 times as great as that of the earth.

* The attention of electro-chemists is called to the "Elektro Chemische Zeitschrift" in the German language), which we believe is the only journal devoted exclusively to the subject of electro-chemistry; each number, besides containing original articles, includes also a digest of the principal articles on electro-chemistry published in other journals. It was started in April of this year and is published monthly by Dr. N. von Klobukow, in Berlin, Koethener St., No. 44. The subscription price in this country is 18.40 marks, or about $4.50.

New Books.

THE PRINCIPLES OF ELLIPTIC AND HYPERBOLIC ANALYSIS. By Alexander Macfarlane, M.A., D.Sc., LL.D. Boston: J. S. Cushing & Co. 47 pages, 15 diagrams. Paper. Price 50 cents.

This pamphlet, like the one by the same author "On the Definitions of the Trigonometric Functions," already reviewed in these columns, is a reprint of a paper read before the Mathematical Congress at Chicago, Aug. 24, 1893, with the addition of new matter relating to the trigonometry of the general ellipsoid and hyperboloid. The work is another contribution to the system of vector analysis developed by the author, being the fifth publication on the subject. The part of the subject here treated is the extension of the versor analysis from the simpler cases pertaining to the circle, equilateral hyperbola and logarithmic curve, which were treated in the preceding papers, to the more complex cases involved in the geometry of the sphere, the general ellipsoid and the general hyperboloid.

The author aims to construct a system to take the place of the Hamiltonian quaternions, to be at once simpler (that is, less inscrutable) and more rational and logically consistent with the rest of mathematics. In this we are inclined to think he has succeeded (although it must not be thought that his method can be mastered without patient study), and he certainly shows power as an original and independent thinker.

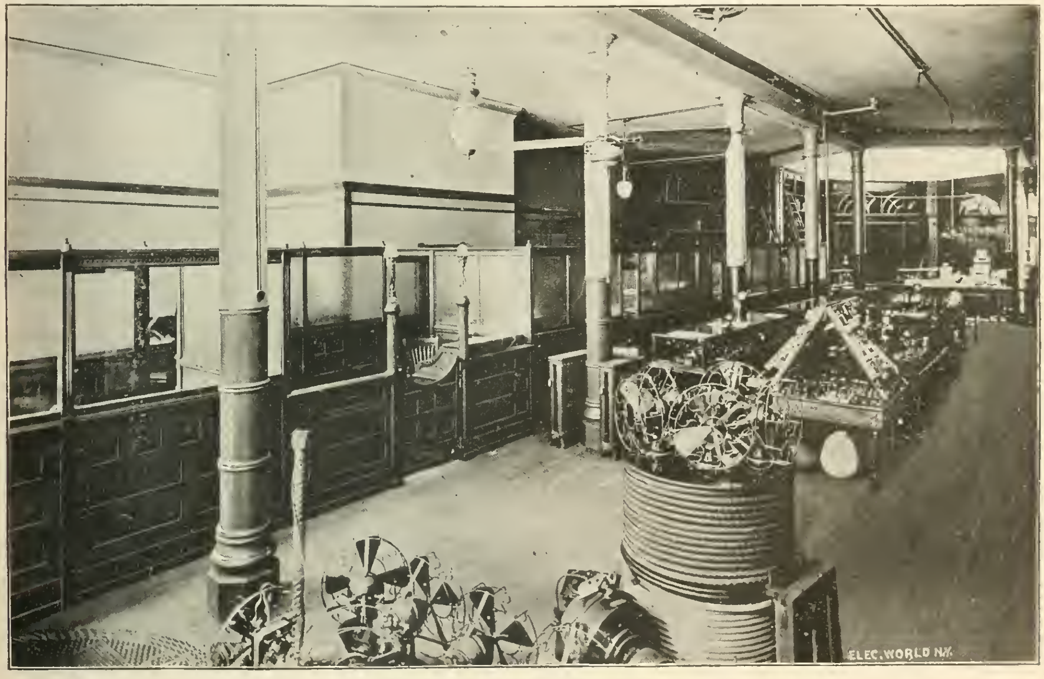
NOTES.

We have received a pamphlet entitled "The Coming Railroad; the Chase-Kirchner Aerodromic System of Transportation," which describes a system of transportation denoted as a "compromise between the present railroad and aerial navigation." One of the inventors is Lieut. George N. Chase, of the United States Army.

The system consists of an elevated iron structure with four girder rails and two trolley conductors for a single-track road. The driving wheels with direct connected electric motors, run upon the upper girder rails, while idle wheels are arranged beneath the lower girder rail, and controlled by compressed air for use in case of necessity to prevent derailment and also to brake the car by throwing the wheels into contact with the rails, and at the same time into contact with a brakeshoe on the car body. The projectors undertake the construction of a car which will be able to "run upon the air" at great speed, guided by a track and supplied by electric power from central stations. For this purpose they have sets or banks of adjustable aeroplanes, the area of which may vary for different kinds of cars, from 2,000 to 4,000 square feet; the adjustment of their pitch is regulated by the engineer in charge. It is proposed to introduce grades when necessary to avoid lateral curves and utilize the planes for assisting them over grades by lifting the cars to the extent of the lift of the aeroplanes. They argue that if on a grade the maximum lift for a level can be maintained by calling into action a reserve of power (the planes) the weight so compensated for may be left out of further consideration, and "if the grade should be too steep for the remnant of the weight to preserve the requisite traction, sufficient artificial friction can be generated by the air pumps and friction wheel beneath the car."

As the driving wheels, however, run upon the upper rails, it is not made clear how any driver beneath the car will maintain the requisite traction when the planes lift the car or even tend to lift it. It is well known to locomotive engineers that the higher the speed the greater must be the traction. There is a disclaimer to any advantage of the aeroplanes for straight roads, in which case thesystem would be an electric elevated railroad, using four rails instead of the ordinary two. The pamphlet is interesting for the statistical railroad data and atmospheric resistance tables which it gives, as well as for its discussions of the principle laid down by Langley, Maxim and others in relation to aeroplanes.--(St. Louis, Mo.)

The Proceedings of the Electrical Society of Cornell University for 1894 contain a number of papers on various electrical subjects, most of which are resumes or reviews, and apparently represent studies supplementary to the college text book course. The titles are as follows: "Lead Secondary Batteries," "The Counter Electromotive Force of the Voltaic Arc," "The Design and Construction of Power Stations," "Power Station Switchboards," "Feeder Systems," "The Development of the Incandescent Lamp," "High Speed Electric Railroading," "Notes on Some of the Work of Nikola Tesla," "The Tesla High Frequency Phenomena," "Long Distance Transmission of Power." In almost all of the papers the subject is historically treated, and in many references are made to various sources of information, in most cases authoritative ones. The present brochure is the first issued by the Electrical Society, which was organized on Nov. 20, 1893, and whose meetings for the reading of papers and discussion of live topics are held semi-monthly. This first volume of its publications gives promise that the society will fulfill the hope of its founders, if indeed it does not already do so, of ranking "among the foremost engineering societies in American universities."—(Ithaca, N. Y.)



New Home of the Central Electric Company.—Bookkeeping Department.

The New Home of the Central Electric Company.

The history of every successful concern is one of change, a gradual evolution from small beginnings to the greater proportions which maturity and prosperity bring. With the growth of business there comes the necessity for more convenient and commodious quarters. Starting with very humble accommodations, the successful company soon finds itself in a comfortable home. The well-known supply house, the Central Electric Company, of Chicago, affords a good illustration of this. The company has not only moved once, but thrice. At the time of its organization in 1887 it occupied small salesrooms on the second floor

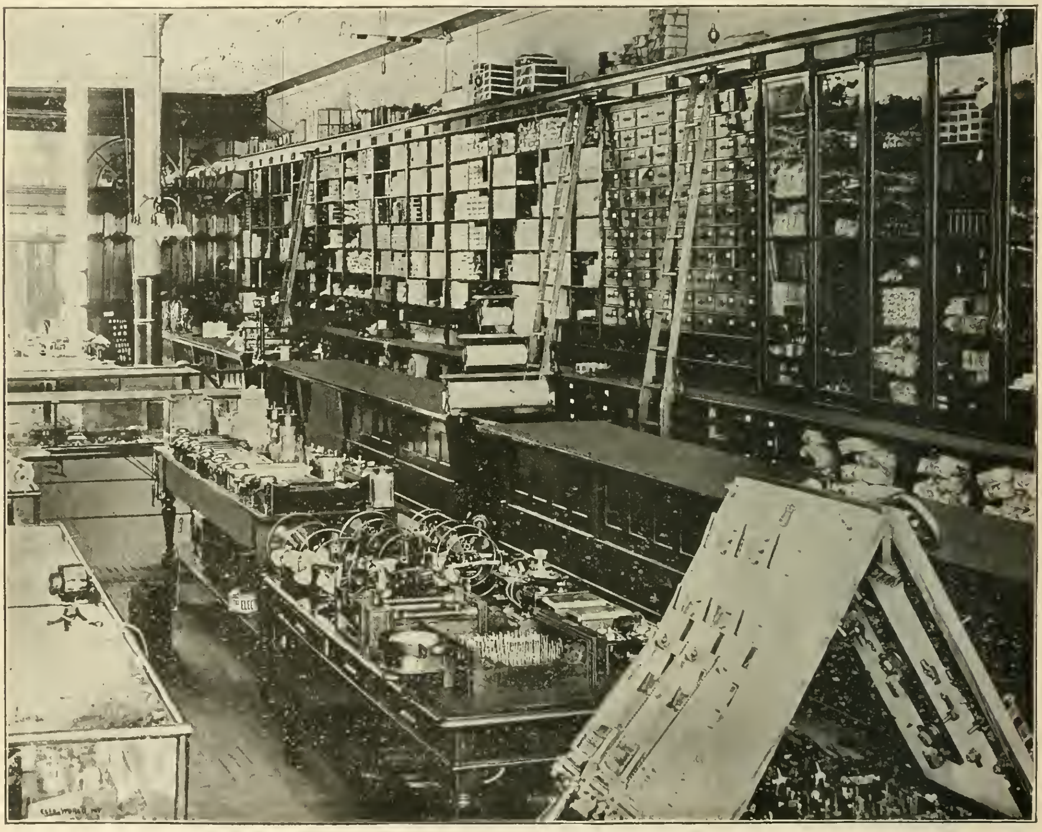
at 38 and 40 La Salle street. The following year it moved only a short distance to 42 La Salle street, where it found more comfortable accommodations. Two years later, however, these were found inadequate, and in January, 1890, the company again moved, this time to locate at 116 and 118 Franklin street, which soon became a well-known center for electrical supplies. The rapid growth of the business, however, soon demanded another change. The company desired this time to choose a site that might serve as a more permanent home, and after careful consideration, located at 173 and 175 Adams street. The Edison General Electric Co., and later the General Electric Company, formerly occupied this building. The Central Electric Company took possession in April last, after the building had been somewhat remodelled, and placed in good condition for its occupation. The location is a fine one, being accessible to the various depots and freight houses, and to the different cable lines, and situated in the central part of the business portion of the city.

On the spacious ground floor of the building the offices, salesrooms and shipping department of the company are located. To the left of the main entrance are the offices, while the sales offices are on the right. Room has been provided for the display of many of the finer grades of goods in show cases, and on sample tables. Sample fixtures of various kinds will be shown in a room which is being fitted up for that purpose for a fixture department. The rear of the main floor is occupied by the shipping department, and an alley at the back of the building makes it convenient for loading and unloading trucks. The elevator is so situated that goods from the different floors may be loaded directly from the elevator to the truck. The president's office is readily accessible, but at the same time, of course, has the desired privacy.

The various departments are each in charge of an experienced salesman, who is able to furnish information to customers in regard to his own department, and who is familiar with the methods of manufacture and the condition of trade in his particular line.

W. H. Huddlestone is in charge of the motor department, the company being the agents for the well-known Lundell motor. The house goods department, including hotel and office electrical goods, is in charge of W. R. Pinckard. A complete line of annunciators, bells, batteries, etc., are included among the stock of the company. Special facilities are provided whereby the shipment of goods is easy and rapid. Okonite wire is one of the commodities for which the company is widely known. Interior conduit is also one of the staple articles, and special provision has been made to illustrate this method of wiring by a sample installation on the main floor.

To the efforts of George A. McKinlock, the energetic president and general manager, the success of the company is in no small measure due. Mr. Charles E. Brown is the secretary of the company, and has been connected with it for several years. The staff throughout is an able and efficient one.

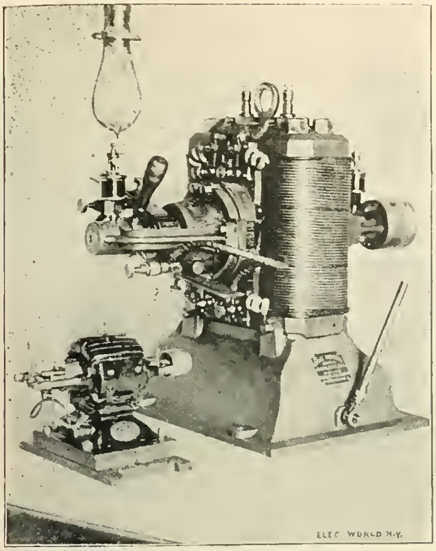


New Home of the Central Electric Company. Retail Department.

An Amateur's Practical Work.

The result of a beginner's effort, is illustrated in a complete little electric lighting plant, designed, constructed and installed, unassisted, by Mr. G. E. Dunton, of Augusta, Maine. The accompanying illustrations are taken direct from photographs of the machines and switchboard. Becoming interested in the elementary principles of applied electricity, Mr. Dunton naturally read and studied such literature treating this subject as came within his grasp, with a result that he has, with a small lathe and a few tools, constructed the apparatus shown herewith. The dynamo is of the two-pole, double-magnet type, with a series wound field, and cores eight inches long. The capacity is 20 amperes, at 55 volts. The weight of the dynamo complete is 156 pounds, giving an electrical efficiency of 6.41 watts per pound of metal used in construction. The total height is 18 inches from floor to top of eye-bolt, and the space occupied by the base 10 by 15 inches. The little motor on 55 volts, and from nine-tenths to two and one-half amperes, develops over one-eighth of a commercial horse-power, and has driven two sewing machines, a large planing machine, and a thirty-six inch grindstone, for business, starting each from a standstill. It will drive a twelve-inch, six-bladed ventilating fan, placed directly on the shaft, in place of the pulley, at 3,500 revolutions per minute. It is compound wound, of the two-pole, double-magnet type, the core being made from a piece of two and one-half inch, ordinary steam pipe, two and one-half inches

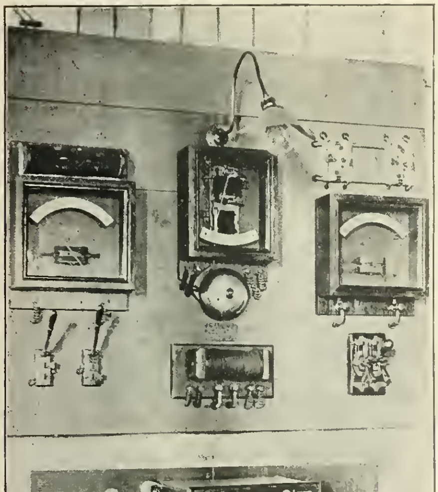
long. The total height is five and three quarters inches from the bottom of the base to the top of the eye-bolt. The base occupies a floor space



AMATEUR DYNAMO AND MOTOR.

of four and one-half by five and three-quarters inches. The motor weighs, complete, nine and three quarters pounds.

The simplicity of construction, positive action and sensitive balance



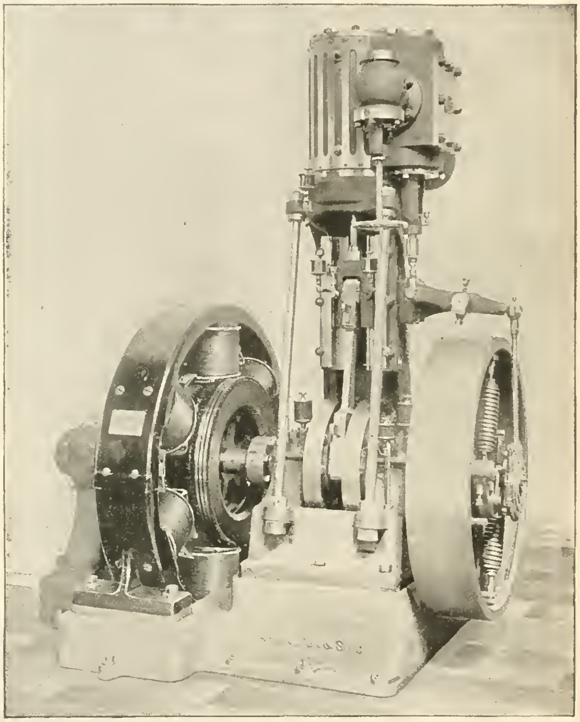
AMATEUR SWITCHBOARD AND INSTRUMENTS.

are marked features of the instruments, and highly creditable. The volt-meter (at the left, on the switchboard) has a range of from 0 to 60 volts. The meter, on the extreme right, as adjusted, has a capacity of 60 amperes. Both these instruments have direct reading scales, and are positively dead beat in action, no springs or gears being used in their movements. The circuit tell-tale, or alarm indicator (in the center) will automatically ring a continuous alarm upon any unusual interruption of the current in the circuit. The bell is rung moderately on an open circuit, but violently upon too much current or a short circuit, and will continue ringing until relieved or switched out. The adjustment is for 20 incandescent lamps; should one more be turned on, the alarm will sound. The movement of this instrument is so sensitive in adjustment that when the arc lights are thrown into circuit, the pointer will show the least variation in the arc, hardly perceptible to the eye. The pointers in these instruments are hung on pivoted balances. The scales are of white enamel on copper. The switches are laid on slate bases, and their alignment is good. The double-throw is of original design, called the "quick-lightning." The rheostat is in a fire-proof, iron and slate box. It contains about 810 feet, No. 16 iron wire, divided into 100 coils. The segments to which the coils connect are all "cold-chiselled" out from three-sixteenths sheet copper and filled up.

Mr. Dunton in all his construction has displayed much ingenuity; without any instruction or previous experience, he drew his own plans, made all patterns required for castings used, shaped and fitted all parts (as far as machinery at his disposal would permit), and did all his winding unaided.

A Compact Plant.

The accompanying illustration shows one of the four compact plants which the General Electric Company has recently installed in the Manhattan Life Insurance Building, New York.



A COMPACT PLANT.

It consists of a six-pole, 25-kilowatt, 300-revolution iron-clad generator, connected to the shaft of an Armington & Sims vertical 40-h.p., 9½ x 10 inch engine. The other three consist of 50-K.W. generators, and 30-h.p. engines.

These small direct connected generating sets are now being built in large numbers by the General Electric Company at its Schenectady works, the demand for them having become very urgent. They occupy but comparatively little space, and this feature alone would recommend them highly for all isolated plant or marine work; they are solidly and substantially reliable, and wherever they have been installed have given perfect satisfaction.

Electric Alarm and Pressure Gage.

The object of the invention we illustrate, manufactured by The E. G. Bernard Company, Troy, N. Y., is to provide an electric alarm signal or high or low pressure that can be atached to all forms of pressure gages. At the same time, it is provided with a simple means of testing the gage and signal apparatus to see if they are in working condition at all times.

Fig. 1 is a view of the face of a common form of a pressure gage provided with the alarm attachment. The small lever or finger to the right, if pressed either up or down, will test the gage in either direction for

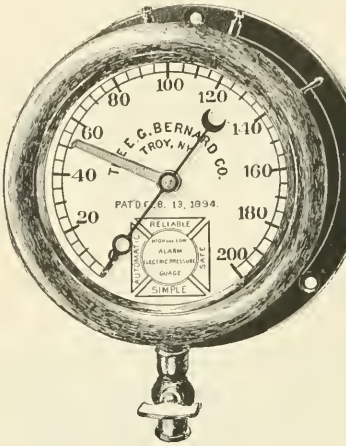


Fig. 1.—Alarm and Pressure Gage.

high or low alarms, thus showing that both the gage spring and the electric signal apparatus are in perfect order. The value of this attachment is obvious, as any device of this kind, which cannot be easily and

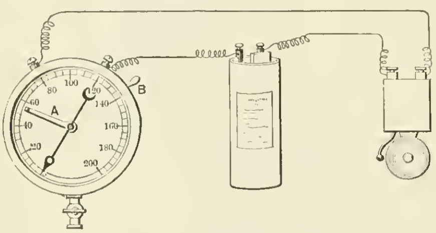


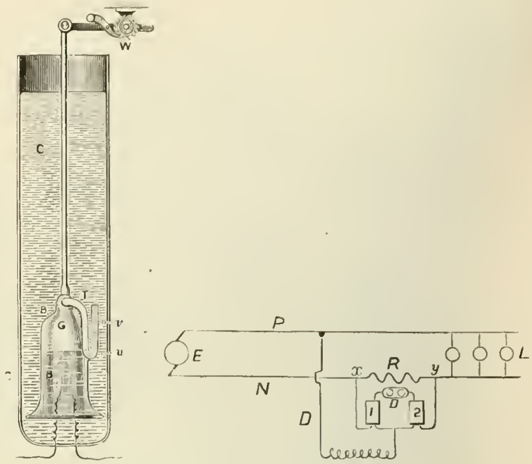
Fig. 2.—Diagram of Connections.

constantly tested is always held in distrust on account of actually increasing instead of diminishing danger.

Fig. 2 is a diagram of connections, which makes evident the simplicity of the system. Besides its use on steam boilers the gage is peculiarly adapted for both wet and dry sprinkler systems, both to indicate if the apparatus is in working order and give an alarm in case of leaks.

The Waterhouse Electrolytic Meter.

The principle of the Waterhouse electrolytic meter, which has recently been brought out, is shown in the accompanying illustrations, Figs. 1 and 2. Electrolysis of a 12 per cent. solution of sulphuric acid takes place beneath a suspended glass bell jar, having a siphon attached to the top as shown; as the gases are collected the bell jar rises, and when the quantity of gas is sufficient to force the liquid out of the siphon tube, the gases will discharge themselves through this tube, the bell jar will sink, and in doing so will register on a suitable integrating device, which will, therefore, register the number of times that the gas collector has been filled and emptied. As the loss of voltage in the meter is limited to 0.5 volts, which is too little for electrolysis, the current for producing electrolysis in the meter is taken from the positive main, as shown in Fig. 2, passes through a resistance of 1,200 ohms, then divides, passing through two of these electrolytic measuring devices 1 and 2, and thence to the points, x, and, y, at the extremities of the resistance R, through which the main current to be measured passes, the maximum difference of potential between x and y being 0.5 volts; the meters 1 and 2 operate differentially, only their difference being registered; when no current is required for the lamps, the same current will pass through the two meters, and nothing will be registered, but when a current passes through R to the lamps, a difference of potential will be produced between, x, and, y, which will cause one meter to register more than the other, the difference, which is shown on the dial, being then a measure of the current in the main circuit. By this device any effect due to changes of resistance caused by heat, or change in the specific density of the liquid, are counteracted, and thereby some of the chief difficulties of electrolytic meters are overcome; owing to the differential action, extreme sensitiveness is obtained, besides a great range; it is free from complications of resistances or parts requiring careful measurements; is easy to calibrate and cheap to construct. A change in the voltage of the mains does not materially affect the meter, owing to the differential action of the two cells; a special device is added which cuts off the shunt current when all the lamps are turned out, and starts it again as soon as one of the lamps is turned on; only pure water is used in refilling the cells, and this is required only once every three months. Several other arrangements differing in the connections



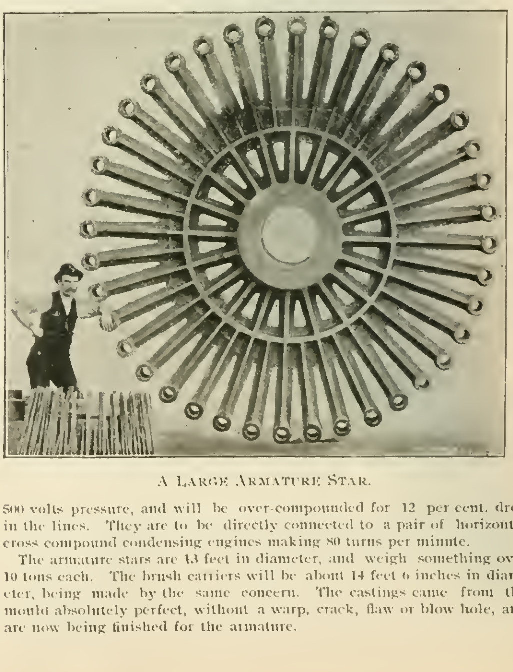
Figs. 1 and 2.—Electrolytic Meter.

between the cells and the mains are described and illustrated in the foreign journals, but the form shown in Fig. 2 herewith is the one which will probably be adopted, as it has very important advantages over the others. It is also proposed to apply this voltameter principle for producing non-wasteful shunts, safety shunts for series motors run at constant current circuits, etc.

A Mammoth Armature Star.

In the accompanying illustration is shown one of a pair of probably the largest armature stars or carriers in the world. A pair of them have recently been made by the Wells & French Company, for the Siemens & Halske Electric Company, of America, who will install them at Toronto, Ontario, for street railway service.

The machines when completed will weigh about 60 tons each, and have a nominal capacity of 1200 kw. or 1600 electrical h. p. each, under



A Large Armature Star.

500 volts pressure, and will be over-compounded for 12 per cent. drop in the lines. They are to be directly connected to a pair of horizontal cross compound condensing engines making 80 turns per minute.

The armature stars are 13 feet in diameter, and weigh something over 10 tons each. The brush carriers will be about 14 feet 6 inches in diameter, being made by the same concern. The castings came from the mould absolutely perfect, without a warp, crack, flaw or blow hole, and are now being finished for the armature.

FINANCIAL INTELLIGENCE.

THE ELECTRICAL STOCK MARKET.

New York, June 30, 1894.

THE ELECTRICAL STOCK MARKET, in common with all speculative markets, is apparently awaiting the distribution of the large dividend and interest payments on July 1, before developing any decided turn to quotations. Just at present there is no appreciable outside interest to speculation, but it is argued that a new impetus must be given to all kinds of securities by the endeavor to place the large July disbursements—New York, Boston, Philadelphia and Chicago are expected to pay out on that date something like $125,000,000—renumeratively, and, while traders are disposed to feel bearish on one or two securities, the odds just now are all against any continued bear campaign.

AMERICAN BELL TELEPHONE has furnished the chief topic of gossip and thought in financial electric circles, by reason of the veto by Governor Greenhalge, of Massachusetts, of the bill permitting the company to increase its capital stock to $50,000,000, and the refusal of the Massachusetts Legislature to pass the bill over the veto. The Governor's action was, to put it mildly, unexpected. To the friends of the Bell Company the veto came like a thunderbolt from a clear sky, as it was thought that, after the approval given by the Legislature to the matter, the Governor would not block the way. Speculative sentiment condemns the Governor; naturally so, as it effectually wipes out a good many "plums," long and fondly anticipated. Public sentiment on the matter is divided, though there is a general disposition to regard the veto as a wholesome check to a species of legislation hardly in accord with the safest and most conservative modern ideas. The effort to secure the legislation to allow it to issue some $30,000,000 new stock to stockholders, at par, has cost the American Bell Telephone Company a pretty penny. It is current gossip that $250,000 were expended in lobbying and other necessary means of "expediting" legislation. This is now all clear loss. On the day when the Governor's veto was made public the stock closed at 202. On Wednesday morning it opened at 190, a loss over night of 12 points. It went down further to 188, but recovered later on, and is now 195, a net loss for the week of 7 points. There is no real reason why the stock should sell much lower. It can still earn and pay 3 per cent. quarterly, although business just now is not over good. This is proved by the statement of instrument output for the month ending June 20, which shows: Gross output, 9,126; returned, 6,316; net, 2,810; a decrease of 1,668. Since December 20, the record for six months shows: Gross output, 41,025; decrease, 11,324; returned 34,695; increase, 6,761; net output, 6,330; decrease, 18,085.

GENERAL ELECTRIC, though not very prominent in the tradings, has been strong at odd times during the week on covering of short contracts. The bears have become disgusted with their inability to create a serious depression in the stock's price, and have determined to close out their contracts. This has lead to some buying, enough at all odds to lend a species of firmness to quotations. People who are bullish on the stock say that, when the whole stock market turns, General Electric will be one of the leaders. They point to its increasing business; the contract to equip the Chicago Metropolitan Elevated Railroad being particularly profitable, and general trade, especially the item for supplies and renewals to subordinate companies, being also very good. With every note paid and with $600,000 cash on hand, the General Electric Company has assumed an unusually strong financial position, and is now able to take advantage of every favorable opportunity in the electrical trade that may present itself. Apropos of the recent sharp advance noted in the stock, a pretty piece of gossip comes from Boston. It is asserted that the little boom was largely due to buying for the account of people who had the tip that some sort of an alliance with the Westinghouse Company was shaping. As the story goes, they held patiently on to their purchases, awaiting developments; but, as these did not materialize, and as the officials on both sides hastened to deny the existence of any negotiations looking to any such consolidation, the people who had loaded up unloaded again and at a loss. And now there are some people down East who are very sore and whose belief in the value of "outside tips" has been rudely shaken. No importance is attached here to the receivership of the Western Electric Company, as all it owed to the General Electric Company was well secured.

WESTINGHOUSE ELECTRIC common stockholders continue to be regaled, as a sort of antidote for their disappointment at not receiving this time the long expected quarterly dividend with stories of big business and prosperity. Last month's manufacturing output is stated to foot up about $550,000, with orders received for about the same amount of new apparatus. From headquarters comes confirmation of the statement made in these columns two weeks ago, that an active campaign was contemplated in the local electric lighting field in New York city. The district is to be flooded with the new lamps now being turned out at Brinton at the rate of 4,000 a day by reason of the success of the new glass works. The lamps will be offered at 25 cents to users of Westinghouse apparatus, with a discount of 20 per cent. for large lots, the value of the return bulb being placed at 4 cents, instead of 10 cents. When the new factory is in complete operation by October 1, next, it will have a capacity of 30,000 lamps. There have just been bought at Brinton 14 more acres of land, making 37 acres for the new works, and everything will be complete by the date specified. The pay roll of the company is said to show a continuous increase.

FT. WAYNE ELECTRIC matters still occupy some prominence, though there is absolutely nothing doing in the stock. It is charged that the old company has not, as asserted, sold out to the Ft. Wayne Electric corporation, and some interesting developments are awaited when one or two opposing stockholders will take the whole matter to the courts for ventilation.

THE STREET RAILWAY & ILLUMINATING PROPERTIES have purchased another 507 shares of preferred stock at an average price of 98.6 per cent., and are in the market for more.

WESTERN UNION TELEGRAPH is absolutely featureless, though there are rumors of a bull pool being formed to lift the stock at an early date into activity and higher prices.

THE INTERIOR CONDUIT AND INSULATION CO. have declared a 5 per cent. scrip dividend, which is convertible into fully paid capital stock. The transfer books will be closed at 3 p. m. July 16, and the dividend will be paid August 1, 1894. This is the first dividend of the company, and it is somewhat of a surprise to the stockholders. The company has been doing an excellent business in fan motors and other of its specialties, so that it was supposed a good cash dividend would be declared. The sales on one day last week, for instance, amounted to 345 fan motors, and in addition 30 motors of a large size. The directors say that while the company has earned enough to pay about 10 per cent., it is considered best to use the money in the business and in accumulating a surplus.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric Co.	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
* Edison Electric Ill., New York	100	99	100
* " " " Brooklyn	100	101	102
" " " Boston	100	116	115
" " " Chicago	100	135	145
* " " " Philadelphia	100	128	130
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com	15	15	17½
" " " " " pref.	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	36	36⅛
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref.	50	50½	51½
BONDS.			
Edison Electric Ill., New York	1,000	106¼	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86¾
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	195	196
American District Telegraph	100		45
American Telegraph & Cable	100	88	89
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	—
Gold & Stock Telegraph	100	102	104
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	83⅛	83⅝

* Ex. div.

NEW INCORPORATIONS.

THE DRAWBAUGH TELEPHONE COMPANY, Boston, Mass., capital stock $10,000,000, has been incorporated.

THE NORTH JERSEY STREET RAILWAY COMPANY, Newark, N. J., capital stock $5,000,000, has been incorporated.

THE OHIO HARRISON TELEPHONE CONSTRUCTION COMPANY, Norwalk, O., capital stock $20,000, has been incorporated.

THE ELECTRIC MEDICAL ASSOCIATION OF WEST VIRGINIA, Wheeling, W. Va., has been incorporated with a capital stock of $5,000.

THE CORAOPOLIS ELECTRIC LIGHT COMPANY, Coraopolis, Pa., capital stock $5,000, has been incorporated by W. H. Guy and others.

THE ROGERS PARK LIGHTING COMPANY, Chicago, Ill., capital stock $30,000, has been incorporated by Henry Heistand and others.

THE PHILADELPHIA & TRENTON STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock $150,000, has been incorporated.

THE ELECTRIC FIRE PROOFING COMPANY, New York, capital stock $150,000, has been incorporated by Edwin A. Bradley and others.

THE COVER CURRENT MOTOR COMPANY, Everett, Wash., capital stock $100,000, has been incorporated by John M. Cover and M. O. Tibbits.

THE ECONOMIC ENGINE COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated to manufacture electric motors and engines, etc.

THE ROXBOROUGH, CHESTNUT HILL & NORRISTOWN TRACTION COMPANY, Philadelphia, has been incorporated with a capital stock of $5,000.

THE MICHIGAN HARRISON TELEPHONE CONSTRUCTION COMPANY, Grand Rapids, Mich., has been incorporated with a capital stock of $50,000.

THE INFINITY MANUFACTURING COMPANY, New York, capital stock $4,000, has been formed to manufacture dry batteries. J. J. Solomon, 59 East 111th street, Davis B. Hart, 146 West 48th street, and J. I. Hart, 47 West 56th street, New York, are the promoters.

THE CLEVELAND & ELYRIA RAILWAY COMPANY, Cleveland, O., capital stock $100,000, has been formed to build and operate a street railway to be operated by electric or other motive power, etc. B. F. Phinney, Jay Comstock, H. D. Coffinberry, J. M. Gasser and Dallas Beebe are the organizers.

KANSAS CITY ELECTRIC STREET RAILWAY COMPANY, Kansas City, Kan., capital stock $1,000,000, has been formed to construct and operate a street railway. E. L. Luggren, Benj. Jones, Ozone Park, N. J.; F. B. Wilcox, Kansas City, Mo.; L. Hummel, West Chester, Pa.; J. F. Parrott, R. A. Kope and P. F. Spickler, of Kansas City, Kan., are interested.

THE LEAVENWORTH ELECTRIC RAILROAD COMPANY, Leavenworth, Kan., capital stock $300,000, has been formed to construct and operate a railroad by steam, electricity, or other motive power; also telegraph and telephone lines. The promoters are W. D. Bethel, Memphis, Tenn.; N. H. Smith, Boston, Mass., and Newman Erb, New York.

SPECIAL CORRESPONDENCE.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 2, 1894.

NIKOLA TESLA has received the degree of M. A. from Yale College.

THE RUGGLES-COLES ENGINEERING COMPANY, 29 Cortlandt street, agents for the Pittsburg Gage Co., is meeting with very gratifying success with water columns and gage cocks, especially for use in electric light plants.

L. AUERBACHER, of the Automatic Electrical Speciality Company, 136 Liberty street, New York, has recently been appointed agent for the sale of the New Beacon lamp. Mr. Auerbacher reports business exceedingly good in all his specialties.

H. G. ISSERTEL, late manager of the street railway department of the A. B. C. Company, has accepted a position with the H. W. Johns Manufacturing

Company. Mr. Issertel's thorough knowledge of the street railway and general electrical trades will have through this connection a fine field for its exercise.

T. J. MURPHY & CO., 136 Liberty street, have recently made an addition to its factory, 810 Greenwich street, this city, where the company will keep a large stock of slate and marble constantly on hand, which can be cut to the required size. This new departure has been made in order to provide for its customers who may not be able to wait long enough to get what they require from the quarry.

MR. THOS. A. EDISON met with a severe accident last week which, though causing considerable suffering, fortunately entailed no serious consequences. While sitting on a porch the hind legs of his chair slipped over the edge, throwing Mr. Edison backward to the ground several feet below. Owing to his weight the fall might have been fatal, and at one time it was thought that some internal injury had been received; after several days' confinement to his room, however, Mr. Edison is rapidly convalescing.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., June 30, 1894

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., have recently added to their varied list of specialties those of the Billings & Spencer Co., of Hartford, Conn., for the Eastern district, and have already secured several very large orders for the well-known commutator bars manufactured by this company. General Manager Price reports business generally as being unusually good. The motor department is making an extraordinarily good showing, and so is the railway department, quite a number of good-sized contracts for overhead equipments having been booked recently.

CANADIAN NOTES.

OTTAWA, June 30.

ST. JOHN. N B.—The St. John Electric Street Railway has elected the following directors: Sir Wm. Van Horne, president; James Ross, J. J. Tucker, H. P. Timmerman and H. H. McLean.

HAMILTON.—At a meeting of the directors of the Hamilton Street Car Company it was decided to try the experiment of a limited Sunday car service. For a few Sundays about half the regular number of cars will be run from 10 to 1, from 2 to 5, and from 6 to 10.

OTTAWA, ONT.—At a meeting of the Railway Committee of the Dominion Parliament, an act to incorporate the New York, New England & Canada Company was adopted. The preamble of the bill to incorporate the Boynton Bicycle Electric Railway Company, projected to run from Winnipeg to Louisburg, Cape Breton, was adopted. The further consideration of the bill was adjourned until the promoter was able to give fuller information.

OTTAWA, ONT.—Letters patent have been issued to Messrs. David Maclaren, of Ottawa, lumber merchant; Alexander Maclaren, of Buckingham, lumber merchant, as the Gibbs-Franchot-Maclaren Company, the works to be on the Lievre River, to manufacture and produce chlorates, acids, alkalis and other things. Their charter gives them power to operate mines, electric light and to manufacture packages and keys, the capital stock to be $50,000.

OTTAWA, ONT.—A meeting of the directors of the Chaudiere Electric Light Company was held in the office of Messrs. Ahearn & Soper, Monday evening. A dividend of 8 per cent. was declared, payable on July 1. The annual report showed that there were 26,000 lights in operation, and that 8,000 had been installed during the year. The board was re-elected as follows: G. P. Brophy W. Y. Soper, J. W. McRae, T. Ahearn, T. Workman, Robert Hurdman, W. G. Hurdman, William Scott and William Hutcheson.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, June 20, 1894.

ELECTRIC RAILWAYS IN LONDON.—Work on the electric railway, which will run from Waterloo under the Thames into the city, has been commenced.

ELECTRIC RAILWAY ENTERPRISE IN LONDON. As I foreshadowed in a recent letter, the London County Council has succeeded in killing yet another scheme. By its injudicious insistance upon the insertion of onerous clauses in the bills of several schemes, they have already succeeded in maintaining the majority of these projects in a state of suspended animation. The British public is long-suffering, but it has not yet been disciplined into gratuitously providing money for the comfortable carriage of the British workman from his suburban residence to his daily labors.

ELECTRIC LIGHTHOUSES.—Another instance of the failure of the electric light to pierce a fog was recorded at a recent Board of Trade inquiry into the wreck of the steamship Jasper. This vessel was carried out of her course in a dense fog, and struck the rocks within 500 yards of the May Island electric light; the glare of the light being only noticed two minutes before the vessel struck. The May Island light was erected about eight years ago, and in clear weather can be seen for a distance of 20 miles. A sailor who gave evidence at the inquiry stated that on a previous occasion, when he was about a mile off the island, he could not see the electric light, although he could see the oil light on the Fifeshire coast, 2½ miles off.

NEWS OF THE WEEK.

TELEGRAPH AND TELEPHONE.

PITTSBURGH, PA. The American Telephone Company has purchased a lot and will erect a three-story building for a telephone exchange.

OCALA, FLA.—The Ocala Telephone Company has been organized with a capital stock of $10,000. J. C. Carlisle is president.

ST JOHNSVILLE, N. Y., is agitating the question of organizing a new telephone company connecting different villages.

BANGOR, ME.—It has been decided to build a telephone line from Gardiner to Camden, thence to Bangor, and from there to Bar Harbor. The line to Camden will be entirely new, and from there to Bangor the old one will be rebuilt.

ELECTRIC LIGHT AND POWER.

HAWKINSVILLE, GA.—Address J. M. Burrows concerning electric light plant to be established.

FRONT ROYAL, VA.—Address the Mayor concerning $6,000 electric light plant to be established.

FRANKLIN, O.—A movement is on foot to organize another electric light company.

JOPLIN, MO. The Southwestern Electric Light and Power plant of Grand Falls is to be removed to Joplin.

OSAGE, IOWA.—Fire, caused by spontaneous combustion, destroyed the plant of the Osage Electric Light Company. Loss, $50,000, with no insurance.

PENSACOLA, FLA.—The Citizens' Electric Light & Power Company, T. E. Welles, president, is in the market for an entire outfit for an electric light plant.

SUMMIT, N. J.—Summit capitalists are about to form a stock company and erect an electric light plant, which will cost $100,000 and have sufficient capacity to light Short Hills and Milburn.

BROOKLYN, N. Y. The Aldermanic Committee on Lamps and Gas, Alderman Walkley, chairman, is considering the proposition of the Municipal Electric Light Company to extend its system over the entire city.

CRANFORD, N J.—Bids will be opened by the Township Committee for lighting the streets of Cranford by either electricity or gas on July 9. The contract will be for two or five years, and R. C. Plume is the town clerk.

GRAND ISLAND, NEB.—After July 10, unless something new turns up in the interval, Grand Island will be without the electric light. The Light & Fuel Co.'s contract expires July 1, and its new bid has been rejected.

LYONS, IA. The Electric Light Committee was ordered to purchase the following supplies, which they reported as needed: 4,500 feet of line wire, one and a half dozen pulleys, one pair splicing pliers, one pair blocks, 200 wood insulating pins.

ROME, N. Y. Sealed proposals for lighting the streets with electric light will be received until August 6. Proposals must be for one, three and six years, for 150 arc lights, more or less, of 2,000 candle power each. R. S. Putnam is chamberlain.

WASHINGTON, D. C.—Plans have been prepared by T. F. Schneider, Eighteenth and Q streets, for the erection of a $130,000 fire-proof hotel building for Judge A H. Lowery. An engine and dynamo for lighting will be placed in the building.

HARRISBURG, PA.—The Tremont & Pinegrove Heat & Power Co. has received its charter, and commenced work excavating for the erection of the plant, which will be located between Pinegrove and Tremont and will be run by water power.

NORWOOD, PA.—Proposals for lighting the borough of Norwood with from 50 to 100 lights for two years, from August 1, 1894, will be acted upon by the borough council, July 12, 1894. Address G. C. Skelton, secretary, Box 47, Norwood, Delaware Co., Pa.

CRANFORD, N. J.—R. C. Plume, town clerk, may be addressed in regard to sealed proposals for lighting the streets on a two or five-years' contract, with either electricity or gas. Bids to be opened by the Township Committee at its meeting July 9 at 8 p. m.

PALMYRA, N. Y.—At a meeting of the village Board of Trustees, the parties holding a franchise for erecting a plant in this place were given two weeks in which to decide whether they will erect the plant or not. In the former case work will be commenced at once, and a plant put in operation by September 1.

WASHINGTON, D. C.—Sealed proposals will be received until July 6 for furnishing and delivering at the building for the Library of Congress about 90,000 feet of rubber-coated electric wire. Specifications, general conditions and instructions and blank forms of proposal may be obtained on application to Barnard R. Green, superintendent and engineer.

MAUCH CHUNK, Penn.—The Mauch Chunk Heat, Power & Electric Company has issued bonds for $20,000, and purchased two 23-inch and one 24-inch special McCormick horizontal turbines. It is the intention to add a 1,200-light alternator and a 60 h. p. D. C. generator, which will make the capacity of the plant 3,000 incandescents, 60 arcs and 60 h. p. for power.

THE ELECTRIC RAILWAY.

JOPLIN, MO.—The Joplin Electric Railway & Motor Company is to extend its lines to Velena.

STEVENS' POINT, WIS.—The Stevens Point Lighting Company is asking for a franchise for a car system.

NEW ORLEANS, LA. The St. Charles Street Railway Company has applied for a franchise to change its motive power to electricity.

ALVIN, TEX. The building of an electrical railroad from Alvin to Velasco is proposed. W. A. Rowan, of Alvin, can give information.

CHATTANOOGA, TENN.—The Chattanooga Cotton Oil Company will put in an electric light plant to furnish its own light. Address G. E. Richmond.

NEW CASTLE, DEL.—The New Castle and Wilmington electric railway will not be built under the charter granted at the last session of the Legislature.

FOREST CITY, PA.—Attorney S. P. Weedman and Justice W. J. Maxey are interested in the proposed electric railroad to run from Dundaff to Nicholson.

ST. LOUIS, MO.—The St. Louis & Kirkwood Electric Railway Company has obtained a franchise to build an electric road. Address J. D. Hous for any information.

CLAYTON, MO. A franchise has been granted to the Clayton & Creve Coeur Electric Railway Company to construct an electric road from Clayton to Creve Coeur Lake. Philip Deuser is interested.

KINGSTON, N Y.—Reed & McKibben, the contractors who are building the Colonial Electric Railroad, to-day filed a $10,000 lien on the finished property of the company.

JACKSON, TENN.—It is contemplated to reorganize the Jackson & Suburban

Street Railroad Company, and change its road to electric power. P. J. Murray can be addressed.

POWHATTAN, MO.—The Walbrook, Gwynn Oak & Powhattan Railway has executed a mortgage for $100,000 to obtain funds to build and equip a single track electric railway.

TROY, N. Y.—$15,000 has been subscribed to the stock of the proposed electric railroad from Troy to Sandlake. As soon as $25,000 shall have been subscribed other capitalists will furnish an equal sum.

CLAYTON, MO.—The Clayton & Creve Cœur Electric Railway Company has obtained a franchise to construct an electric road. The president of the company is Philip Dueser, who will give information regarding same.

WASHINGTON, D. C.—A project for an electric railroad between Washington and New York city has been brought before Congress in a bill for the incorporation of the National Rapid Transit Railway. Ex-Representative Hemphill, of South Carolina, is interested.

BROOKYLN, N. Y.—An application has been made to the State Railroad Commissioners by the Coney Island & Brooklyn Railroad Company, to substitute the trolley as a means of motive power on the line from Flatbush and Ocean avenues to Greenwood Cemetery.

SPRINGFIELD, O.—General Manager S. L. Nelson, of the Springfield Street Railway Company, is securing estimates for improving the line. The proposed improvements are $40,000 for retracking, $15,000 for new machinery in the power house, $15,000 for new cars, and $5,000 for other expenses.

PITTSFIELD, ME.—It is probable that the proposed electric railroad from Showhegan to Norridgewock will be built. The Worcester Construction Company offer to build and equip the road all in first-class shape for $45,000. If the town will take $10,000 of the stock Mr. Gerald guarantees the building of the road.

WATERTOWN, N. Y.—A certificate of consolidation of the Watertown Street Railway and the Watertown & Brownville Street Railway Company, forming the Watertown & Brownville Street Railway Co., capital $100,000, was filed with the Secretary of State in Albany, June 25. The directors are Byron B. Taggart, Senator Joseph Mullin and others.

SYRACUSE, N. Y.—The Syracuse Street Railway Company has decided to extend its line to Solvay, and a contract has been signed. It was also decided that the company purchase 35 new electric cars and a contract will be made as soon as possible. Specifications and plans for a power house 100 by 150 feet, with a capacity at the start of 1,500 horse power, have been made. The ultimate of the plant will be 3,000 horse power.

MISCELLANEOUS NOTES.

LOCOMOTIVE TESTING AT PURDUE UNIVERSITY is the subject of a pamphlet recently issued by that institution, briefly describing the facilities for that class of work which the university is now prepared to offer students. The pamphlet contains a number of views of the laboratories and locomotives, and it is evident that admirable facilities for locomotive testing are now offered by the engineering course. The engineering laboratory is in charge of Prof. Wm. F. M. Goss.

THE NORTHWESTERN ELECTRICAL ASSOCIATION will hold its Summer meeting in St. Paul July 18, 19 and 20. At the last meeting, held in Milwaukee, 150 were present, and a larger number is expected at this meeting. Representatives from Illinois, Iowa, Michigan, Wisconsin and North and South Dakota have written they they will be present. An excellent programme has been prepared. Current will be furnished to illustrate lectures as well as to accommodate exhibitors. Manufacturers and supply houses will be accorded every courtesy by the association.

TRADE AND INDUSTRIAL NOTES.

S. MORGAN SMITH, York, Pa., has sold to the Mauch Chunk (Pa.) Heat, Light & Power Co. two 23-inch and one 24-inch McCormick special horizontal turbines.

THE CHERRY CHEMICAL COMPANY, manufacturers of the red seal boiler compound, has removed its main office to the Heed Building, 1215 Filbert street, Philadelphia. In our last issue it was incorrectly stated that the removal was to, instead of from, the Betz Building.

J. E. M'GILLIVRAY, 209 Sabine street, Austin, Tex., will shortly be in the market for a stock of electrical goods. Mr. M'Gillivray proposes to handle everything electrical, but most of his work will be in wiring and repairing for lights, bells and annunciators, and installing and repairing motors and fans.

THE OHIO BRASS COMPANY, of Mansfield, O., has issued a neat price list of railway motor bearings. It includes all the different styles of bearings for the various types of railway motors, and makes a very attractive circular. This company is pushing this line of material actively, and is meeting with excellent success

THE NATIONAL LEAD COMPANY, No. 1 Broadway, New York, has issued a little pamphlet on anti-friction or babbitt metals, containing technical as well as trade information on the subject. The babbitt metal of this company is made according to a standard formula, which it is guaranteed does not change to suit a price.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has issued a large 60-page catalogue, devoted to the description of apparatus and system for the transmission of light and power by two-plant alternating currents. The explanatory portions have considerable technical value, and will be of assistance to those desiring to investigate this newer branch of electrical application. Every part of the system is well illustrated by excellent cuts, made by Bartlett & Co., and the paper, press-work and binding are in keeping with these, and the importance of the text.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., has issued a fourth edition of its catalogue of the Weston standard portable, direct-reading voltmeters and ammeters, containing illustrations, price list, etc. Commendable features of the catalogue are the concise manner, devoid of the usual bombast of commercial publications, in which the merits of the instruments are presented, and the brief notes to assist in selecting instruments for desired uses. The testimonials in the final pages are such as but few manufacturers in any branch of industry can boast of having received, whether the standing of the writers or their flattering comments are considered.

THE BALL & WOOD CO. has again been successful in securing, through its secretary and treasurer, Mr. Vincent, one of the largest power contracts which has recently been placed. The order comprises six Ball & Wood improved cross compound condensing engines of 300 h. p. each, for the Hartford Street Railway Company, of Hartford, Conn. It is this type and make of engine which has proved efficient at the Grand Street station of the Consolidated Traction Company in Jersey City, where the duty has been most severe and the engines subjected to almost constant overloads of from 20 to 50 per cent., pending the increase of the power plant. The factory of The Ball & Wood Co. has been running twenty-four hours per day since about June 1, and this Hartford contract will permit no diminution of its force for some weeks.

THE PETTINGELL ANDREWS COMPANY, 72 Federal street, Boston, has issued a 52-page pamphlet, which will be found useful as a technical hand-book by street railway men. About half of the pages are devoted to tables of useful information for the construction of electric railways. The first part contains tables relating to track construction, giving weights and other data relating to rails, rail fastenings, ties, etc. The second part takes up the electrical side and gives much detailed information on line construction and tables for the calculation of line conductors, etc. The remainder of the pages contain illustrations and matter relating to the complete line of electric railway material, manufactured and sold by this enterprising firm.

BUSINESS NOTICES.

ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JUNE 26, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

11,423 (REISSUE). ELECTRIC BURGLAR ALARM; A. Stromberg, Chicago, Ill. Application for reissue May 31, 1894. In an electric burglar alarm circuit, the combination with a flexible surface, of a series of pliable conducting strips, the strips being folded longitudinally and attached by one of the free ends thereof to the flexible surface, and electrical connections between the strips.

521,798. ELECTRIC ARC LAMP; S. P. Johnson, Schenectady, N. Y. Application filed December 20, 1892. This comprises an arm actuated by shunt spools, a lever linked to the arm at one end and the other end actuated by a series spool, in combination with a clutch linked to the lever near its centre as described.

521,799. ELECTRIC MOTOR; J. Lee, Brooklyn, N. Y. Application filed August 2, 1893. This comprises elongated electro-magnets having cores and curved facing flanges, combined with a hollow speed regulator in the magnetic field, a revoluble armature within the regulator, commutator and commutator brushes, the conductor being wound around from the obverse to the reverse face of one of the cores and from the reverse to the obverse of the other of the cores.

521,800. SOUND CONDUCTING APPARATUS; G. A. Leech, New York, N. Y. Application filed August 19, 1893. This comprises a resonator having curves complementary to those of the ear, and adapted to be secured thereto, and an electrode attached thereto.

521,808. PUSH BUTTON; J. P. McLaughlin, Philadelphia, Pa. Application filed March 22, 1893. This comprises a switch and spring tending to open the same, in combination with a push piece and intermediate mechanism for closing the switch, and a trip timed with reference to the intermediate mechanism to uncouple the switch from the latter when it arrives in the closed position, whereby the switch is automatically open after having been momentarily closed.

521,809. ELECTRIC LAMP LIGHTER; J. F. McLaughlin, Philadelphia, Pa. Application filed March 22, 1893. A lamp lighter composed of two electro-magnets, connected in series in a shunt around the lamp terminals, one fixed and the other constituting an armature for the first; a circuit breaking and making wheel in the lamp circuit actuated by the armature, and a push button or key in the shunt, at a distance from the lamp, for closing and opening the shunt.

521,843. RHEOSTAT; B. E. Baker, Bridgeport, Conn. Application filed November 27, 1893. This comprises cores having screws extending from their ends and resistance wires wound around them and connected to the screws.

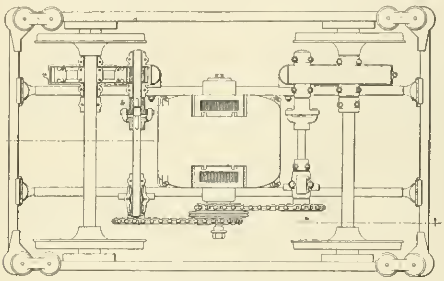
521,867. CONTROLLER FOR ALTERNATING CURRENT MACHINES; E. B. V. Seaverns, Brookline, Mass. Application filed March 29, 1893. The combination with an alternating current machine having a composite field, one winding of which is traversed by a continuous current and is in series circuit with the main line traversed by the alternating current of a switch or circuit controller located in the field winding traversed by the continuous current.

521,877. ELECTRIC ARC LAMP; W. J. Davy, London, England. Application filed April 14, 1894. A gravity friction device, consisting of a system of link,

pivoted together to form a closed frame, grip jaws tending to grip the feeding cord of the lamp, the jaws being attached to a jointed frame in such a position that they approach one another as the frame elongates in a vertical direction, a stop on which the lower end of the link frame rests, and means for determining the position of the upper end of the frame relatively to the stop, according to the resistance of the lamp.

521,891. CONDUIT ELECTRIC RAILWAY; C. J. Reed, Orange, N. J. Application filed April 14, 1892. A pair of positive and negative trolley wires located in a slitted conduit and crossing each other at intervals so as to form succeeding sections in alignment, and beneath the slit of the conduit.

521,892. CONDUIT ELECTRIC RAILWAY; C. J. Reed, Orange, N. J. Application filed February 13, 1893. A trolley consisting of a two-part trolley wheel, one of which parts is provided with an inwardly extending boss or



No. 522,067.—Motor Suspension.

projection, which constitutes the axle of the trolley, in combination with a trolley arm journaled upon the axle, and held between the two parts.

521,906. MAGNETIC SEPARATOR; H. Carmichael, Malden, Mass. Application filed November 29, 1893. The combination of a movable carrier or support and a magnet pivotally attached thereto, and a receptacle through which the magnet is passed.

521,908. AUTOMATIC SAFETY JOINT FOR ELECTRIC WIRES; J. H. Curry, Wilkinsburg, Pa. Application filed November 22, 1893. This consists of a box or support having two insulated anchorage pins, and two arms connected with the pins by a loose-slotted connection with supporting seats for sustaining the arms when under tension, and a bridge connection for the two arms for electrically connecting them when supported by tension in these seats.

521,914. ELECTRIC SOLDERING TOOL; J. F. McLaughlin, Philadelphia, Pa. Application filed May 19, 1893. The combination of a heating coil and a perforated inclosing mantle for the same, with means for controlling the radiation of heat through the perforations.

521,924. TRANSFORMER ELECTRIC-LIGHTING SYSTEM; Peter Wright, Philadelphia, Pa. Application filed December 9, 1893. In a transformer system of electrical distribution, mechanical and electrical devices for breaking and making the primary circuit, and a manual switch and connections for cutting out, and in the secondary circuit, and for controlling the mechanical and electrical devices.

521,925. TRANSFORMER SYSTEM OF ELECTRICAL DISTRIBUTION; Peter Wright, Philadelphia, Pa. Application filed January 3, 1894. In a transformer system of electrical distribution, a switch tending to make and break the primary and secondary circuits of a transformer and a thermostatic device responding to changes in current and adapted to release the switch.

521,936. ELECTRIC ARC LAMP; L. B. Marks, New York. Application filed March 30, 1894. An arc lamp having the arc surrounded by a transparent or translucent inclosure, and a plug in the inclosure provided with a closely fitting opening for transit of the moving electrode, the opening being enlarged at an intermediate point for the purpose.

521,952. ADJUSTABLE CARRIER FOR ELECTRIC LAMPS; R. Faries, Decatur, Ill. Application filed February 23, 1894. An arm for electric lamps, comprising a bracket or support, having an aperture, a rod, one end of which is curved and adapted to the aperture of the support, a lamp socket on the swinging end of the rod and a lamp cord or circuit wire connecting with the lamp socket through a longitudinal aperture in the rod.

521,970. ACCUMULATOR PLATE; C. J. Barbier, Lyons, France. Application filed January 12, 1894. An improved accumulator plate, comprising a flat lead box for containing the active matter, the box having its opposite sides provided with alternately arranged pins overlapping or projecting past each other, the walls of the box having perforations opposite the points of the pins.

521,976. THICKNESS GAGE FOR PAPER-MAKING MACHINES; O. W. Theodor Am Ende, Bad Harzburg, Germany. Application filed November 10, 1893. This comprises an adjustable graduated slide, carrying a contact point, the means for adjusting the slide, the frame in which the slide is movable, the arms pivoted in the frame and depending from their pivotal points, the cross bar at the lower ends of the arms opposite the end of the graduated slide and the contact carried thereby, and the roller carried by the depending arm to bear on the pulp cylinder to move the pivoted depending arms toward the graduated slide.

522,022. THERMAL ALARM; H. F. Maxim, Norfolk, Va. Application filed August 31, 1893. The combination of the index, pivoted pointer, having a slotted heel, a thermostat bar actuating the pointer, and a bar adjustable on the thermostat bar, and having a projection lying in the slot.

522,051. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; R. Fuller, Detroit, Mich. Application filed March 19, 1894. In a brush holder, the combination of a brush-holding socket, having the central transverse guide bearing thereon, a lateral arm extending from the socket, and adjustable tandard in the end of the arm, and a spring secured in the standard, and dapted to engage in the guide bearing of the socket upon the brush.

2. COMMUTATOR; J. D. Fyfe, Chicago, Ill. Application filed April 14, 94. A commutator composed of segments insulated from each other and arranged in the form of a cylinder, and provided with an annular groove in the face or end thereof, a metallic assembling ring adapted to fit into the groove and insulated from the segment, caps located on opposite sides of the segments and insulated from them and the ring, the caps adapted to secure the assembling ring in the grooves of the segments.

522,055. CIRCUIT-MAKER; D. F. Hall, Schenectady, N. Y. Application filed October 16, 1893. A circuit-maker, comprising a bracket, a support in arm pivoted thereto, a battery receptacle having circuit wires secured thereto, and in which receptacle the elements forming the battery are held normally apart, and adapted to coalesce when the receptacle is inverted.

522,057. TROLLEY STAND; E. F. A. Heastings, Avalon, Pa. Application filed April 12, 1894. A trolley stand, comprising a base, adapted to be secured to a car, a pivot post mounted in the base, a bracket journaled on the pivot post and provided with upwardly extending arms, a second bracket held in the arms of the first one and adapted to carry a pole, and bow springs connecting the two brackets.

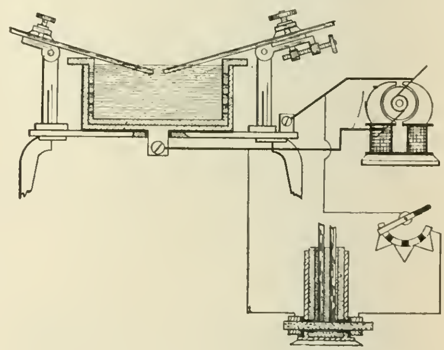
522,067. MEANS FOR SUSPENDING ELECTRIC MOTORS FROM CARS; R. Lundell, Brooklyn, N. Y. Application filed September 4, 1893. A motor, sustained beneath the body or frame of a car upon yielding supports, with its armature shaft located in the direction of the length of the car and sprocket-chain gearing connecting the armature shaft with an additional rotary shaft, which in turn is geared through speed-reducing gearing to two independent car axles. (See illustration.)

522,083. DYNAMO OR MAGNETO ELECTRIC MACHINE; L. Paget, New York. Application filed June 20, 1889. This machine has a rotary part with projecting pole pieces in combination with a fixed or stationary part, having corresponding projecting pole pieces and a single coil wound about the fixed or stationary part.

522,097. ELECTRICALLY OPERATED ADDING MACHINE; R. Baumann, St. Louis, Mo. Application filed September 4, 1893. This machine has grouped within its casing in a horizontal line a series of electro magnets, each elongated in cross sections, and constructed with flat opposite sides closely adjacent, a series of adding disc spindles with ends adjacent the magnets, and in the same plane with them, mechanical connections for rotating the spindles when the magnets are energized, the last mentioned connections being also in the same horizontal plane as the magnets.

522,113. ELECTRICALLY OPERATED REGISTER; S. J. Glass, Milwaukee Wis. Application filed October 23, 1891. A register of that class employed for counting the movement of a reciprocating, oscillating or rotary device or the successive production of various articles, the same comprising a series of counters geared in train to indicate arithmetical progression in the order of units, tens, and multiples of ten, a ratchet connected to the units counter, an actuating lever for the ratchet, another lever linked to the first mentioned, an armature carried by the second lever, an electro magnet for the attraction of the armature, and a supplemental electro magnet for the retraction of the armature, each of these electro magnets being in independent circuit and automatically cut out prior to the energization of the other.

522,127. VOLTAIC BATTERY; H. Timm, New York. Application filed April 19, 1894. This is composed of two absorbent layers, enclosing a dry layer of a soluble electrolyte, a series of metallic plates of different polarity in close



No. 522,151.—Heating Metals Electrically.

contact with the absorbent layers; two other absorbent layers are placed on the outside of faces of the metallic plates; a second series of metallic plates of different polarity in close contact with the last-mentioned absorbent layers, metallic connections between the outside metallic plates, and metallic connections between the inside metallic plates.

522,151. METHOD OF HEATING METALS ELECTRICALLY; C. L. Coffin, Detroit, Mich. Application filed November 16, 1893. This consists in dipping a heated piece of metal into a liquid, passing an electric current through it and the liquid, and establishing a voltaic arc between the electrodes. (See illustration.)

522,175. INSULATOR; J. M. Anderson, Boston, Mass. Application filed March 22, 1894. This is composed of a body portion of insulating metal, a metal crown having upright arms or ears, forming a slot or channel for the reception of the conductor to be supported, and a cap or cover detachably secured to the arms to close the slot or channel at its top or upper portion.

522,180. TROLLEY WIRE HANGER; T. J. McTighe, New York. Application filed January 23, 1893. A trolley wire attachment, consisting of an ear or casting of suitable shape, having a slotted screw threaded stud, adapted to receive the trolley wire, a flat plug substantially filling the slot, and a screw cap adapted to fit the stud, and press the plug against the trolley wire.

622,029. ELECTRIC TIME SIGNALLING SYSTEM AND APPARATUS; W. A Purcell, Newark, N J. Application filed November 16, 1892. The combination with a circuit wheel or drum, provided with a series of contact ribs of definite width, of another rib or ribs of greater width, and a circuit breaker wired to the last mentioned rib or ribs.

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CONTENTS.

INDUCTANCE OF LINES.

Elsewhere in this issue Mr. G. M. Warner discusses inductance drop, which is a matter of increasing importance in connection with alternating conductors. Kennelly has treated this subject thoroughly in a paper read before the American Institute of Electrical Engineers and in an article in our columns last week, but the practical examples worked out by Mr. Warner will be found of much assistance in getting a good grasp of the principles. It will be noted that stress is laid upon the necessity of taking into consideration phase differences in E. M. F., caused by capacity or by motor loads. The ordinary tables of inductance co-efficients are based upon non-inductive loads, and therefore may lead to considerable errors in calculation if applied to lines whose capacity cannot be neglected or which carry current for motors whose inductance throws the current and E. M. F. out of phase.

PERMEABILITY OF STEEL.

Some months ago Mr. H. F. Parshall pointed out in a paper read before the Franklin Institute, an abstract of which appeared in our columns, the great variations in the permeability of steel resulting from the presence of different proportions of carbon and manganese, and of impurities like sulphur, phosphorus and silicon. We print elsewhere an article by Messrs. Osterberg and Munroe containing the result of careful experiments made by them at Columbia College on two different steels, which, in connection with the chemical analyses given, forms another useful contribution to the subject, and strongly confirms the experiments of Mr. Parshall. The conclusions arrived at are of much importance, and besides pointing out the absurdity of basing calculations on conventional permeability curves, they imply that for even the most ordinary commercial work permeability tests of the magnetic material to be used should be made, or, at least, a chemical analysis furnished from which to judge of its magnetic quality. It would be very useful if chemical analyses were made, where possible, of iron or steel subjected to permeability tests, for by so doing it is very probable that the effect of different limiting proportions of carbon and other elements would be finally so definitely determined that the magnetic quality of a material could be approximately determined from a chemical analysis alone.

DOES ELECTRICITY KILL?

In the Digest will be found an abstract of a paper recently presented by Dr. D'Arsonval to the French Academy of Sciences on resuscitation after electric shocks. As D'Arsonval is one of the very greatest living authorities on electro-physiology, his conclusion that in case of electric shock unaccompanied by lesions the subject can be resuscitated by means of artificial respiration is of the utmost importance. Still more startling is his assertion that electrocution, as practiced in this country, does not cause actual death, but merely produces asphyxiation and syncope, from which the criminal may be revived. The latter statement, coming from such a source, cannot be passed over lightly, and should cause the New York State authorities to make the necessary test on the next criminal electrocuted. The case he adduces to support his statement is a remarkable one, for the man who was resuscitated was subjected to an alternating voltage of 4,500 for some minutes, with, it would seem from the description, a contact that could not during the entire time have been of any relatively considerable resistance. It is seven years since Dr. D'Arsonval, from laboratory experiments, formed his conclusions in regard to the effect of electric shocks, and the confirmation received through the case just noted seems to be most complete, and, therefore, his system of treatment is one with which every person engaged in electrical pursuits should be familiar.

D'Arsonval gives the practical formula, *A man shocked by electricity should be treated as if drowned.* In addition to the well-known methods for the resuscitation of the drowned, he recommends the electrical excitation of the laryngeal nerves or rhymthic traction of the tongue. While in a given case D'Arsonval finds that real death may occur from the lesion or destruction of tissues by disruptive or electrolytic effects of a current, these, he adds, seldom occur with the alternating current, and may not follow a shock from a continuous current. As a consequence, every electrician should be prepared in case of an accident to apply the necessary treatment, and to this end should make himself familiar, if not already so, with the method of resuscitating the drowned. Regardless of what the future might show, the actual evidence is now sufficient, aside from the great authority of D'Arsonval, to render it a duty for the electrician to be thus equipped for the saving of human life.

GAS ENGINES FOR ELECTRIC LIGHTING.

In Europe gas engines are much employed in isolated electric lighting, and in several central stations on the Continent they furnish the entire motive power. At Dessau, Germany, for example, the power plant consists of two gas engines of 120 h. p. and 60 h. p. respectively, which charge accumulators of 1,700 ampere-hours' capacity, the annual output being 49,869 kw.-hours. Mr. E. C. Segundo, in the London *Electrical Review*, has recently given some calculations as to the cost of generating current with gas engines, both in private and central station lighting plants, which are rather favorable and show at least that the matter is well worth looking into, particularly in connection with isolated and accumulator station plants. It is stated that a certain English manufacturer will guarantee his gas engines of large power to generate a brake horse power on 18 cubic feet of coal gas per hour, and with an 80 per cent. electrical efficiency this gives 13,200 candle-hours, as against 3,200 if the gas were burned in jets—a ratio of 4.125. Using Dowson gas, the same manufacturer states that his engines will develop one brake horse power on one pound of anthracite coal. We doubt if there is any steam engine now used in electric lighting that will develop a horse power on less than two pounds of coal, so that the saving is here very pronounced, so far as fuel consumption is concerned. With a smaller plant it would be a pretty poor gas engine that would require a consumption greater than 40 cubic feet of gas to the brake horse power. With gas at $1.25, 3-watt lamps, and an electrical efficiency of 80 per cent., this would bring the cost of a 16-c. p. incandescent lamp to 5-12 cent per hour, exclusive of labor and incidentals, while the cost of a 16-c. p. jet, using five cubic feet of gas per hour, would be 5-8 cents. The saving here is $33\frac{1}{3}$ per cent. over burning gas direct, which in a 150-light plant would amount to 31 cents per hour, against which should be charged the cost of water and labor; with a gas engine using 25 cubic feet per h. p. per hour this saving becomes 50 cents. As most establishments that would require 150 lights would have some one about the premises who could look out for the electrical plant with little or no extra expense, and as gas engine electrical plants take up but little room and do not require constant attention, their use for isolated plants presents an advantage aside from the immense superiority of the incandescent light over gas light.

THEORY.

One of the most abused of words is "theory," not only from being made the object of the sneers of the "practical man" and the worshipper of "horse sense," but even more so from its misapplication to designate the wildest speculations and the most absurd fancies. It is singular, but none the less true, that those who most inveigh against theory and theorists are the very ones who have brought the words into disrepute. Given a half-educated man, and therefore possessed of that little knowledge which is dangerous, or an uneducated man, but who is considered "bright" and "brainy" in a narrow community or by an uncultured circle of acquaintances, and we have in either case a theorist in the sense in which the word is condemned, and one, who, with the slightest encouragement, will glibly reel off by the yard what he supposes to be theory, and which his hearers accept as such. We constantly receive smartly written or ungrammatical manuscripts giving the "true theory" of electricity, of magnetism, of the causes of various electrical phenomena, and we do not remember a single one of these which ever contained a real experimental fact upon which to rest the conclusions arrived at. In looking over our newspaper exchanges, particularly those containing an electrical column—that medium for the dissemination of so much electrical misinformation—we can find in a year more theories in number than have been fathered by scientists in a century. We have before us now, in a clipping, a typical example of this class of productions, in which the writer demonstrates to his satisfaction that the rotation of the earth on its axis is due to electrical action. In a manner very characteristic of his type, who invariably treat the theories of others with the loftiest disdain, regardless of their authority, he disposes of the accepted scientific opinions as to the cause of the earth's rotation with the statements that they are "the silliest nonsense, not worthy of a "serious thought," which "might do for monkeys, but should find "no place in the minds of men." "Let reason have a chance and "electricity a hearing," he demands, and then, after describing how a shaft with radial arms may be given motion by the action of static discharges from points on these arms and at right angles to them, he proceeds to develop his theory as follows: "The earth is a "spherical rotating magnet, the electricity coming to it at its north "and south poles, meeting at and going off into space over its equa-"tor. These electrical currents move in spirals. Imagine yourself "off and facing the north magnetic pole of the earth. With your "pencil begin at the pole and make circles to the right, with the "sun, as you face the latter, and each circle nearer the equator. "Not a complete circle, but a continuous line called a spiral. The "electricity coming from space moves with that system of circles "which is called right-handed spirals. Now face the south pole of "a terrestrial globe, or imagine yourself off and facing the south "pole of the earth, and this time draw a left-handed spiral. Begin "at the south magnetic pole and circle from right to left, with the "sun, as you face it, never lifting the pencil, each circle nearing "the earth's equator, and you will have the left-handed spiral, "the movement of the electrical current in the earth's surface as it "comes from space and nears the earth's equator from the south "pole. You will readily see that both north and south of the "earth's equator, the electrical currents, as explained above, would "move from east to west, and this is in accord with the magnetic "records in the geodetic surveys. It will further be readily observed "that the currents coming from the north and south poles of the "earth are moving toward sunset, while the earth revolves toward "sunrise, and if they go off into space they act upon the earth as "explained in reference to the wheel, and the impact on the earth "would cause the latter to rotate eastward." The complacent manner in which utterly false premises are laid down will be noticed, and also the seductive flattery to the reader in the remarks as to how "readily he can see" an impossibility. From sad experience, however, we can add that such benignity may also be united with rancor, and the editor who declines such manuscripts informed that if he had an iota of brains or the slightest knowledge of the science he wouldn't make an ass of himself by denying what any fool could see must be true.

Nomenclature.

Our esteemed contemporary, the London "Electrician," has generally been opposed to burdening any science with new and unintelligible terms which have to be learned, but it seems to have changed its opinion lately, as we find in a recent editorial that the comparatively simple and inoffensive term "Congo red" is referred to as "amidosulphonaphthaleneazodiphenylazonaphthylamine sulphonic acid."

Improving the Human Eye.

"It is just conceivable that at some distant date, say by dint of inserting gold wires or powder in the retina, we may be enabled to see waves which at present we are blind to."—Prof. Oliver Lodge.

Charles Proteus Steinmetz.

Few indeed of those who have followed the advances of modern electricity are not more or less familiar with the important contributions of Mr. Charles Proteus Steinmetz, both to the theory and practice of electrical engineering, and there are few, even among those who had not had the pleasure of personal acquaintance with him, who will not be glad to know something of a more than usually interesting and useful life.

Charles Proteus Steinmetz was born in the city of Breslau, in Southeastern Germany, in the month of April, 1865. After passing through the gymnasium (high school) in his native city, he entered the University of Breslau, and devoted himself especially to the subject of mathematics, which he has put, in later years, to such splendid use. In particular he was a pupil of Prof. Schroeter, then the greatest living authority in synthetical geometry, and Prof. Galle, the great astronomer, who is universally known as the discoverer of the planet Neptune.

After leaving the university, Mr. Steinmetz, having no special inclination for the professions, determined to devote himself to his favorite sciences, and rendering himself independent by becoming an instructor in mathematics, he took up the study in Breslau, and afterwards in Berlin, of various branches of physical science, while not neglecting the study of pure mathematics to which he at first gave his attention. He worked in the physical laboratory with especial success, and undertook an investigation on the secular variation of terrestrial magnetism, unfortunately never finished. Of course, anent his investigations, he has divers amusing reminiscences, particularly on one occasion when, with the help of some friends, he made, with the temperature far below zero, magnetometer readings on the ice of the frozen river Oder, to escape local magnetic disturbances. After a little, his less enthusiastic friends went away "for a few minutes to warm themselves," and after an hour's patient work, Mr. Steinmetz determined to find out what had become of them, and they were finally discovered in a comfortable room playing skat, and waiting for him to finish his observations, which he says eventually proved to be useless because he had forgotten to take off his steel-rimmed eye-glasses.

CHARLES PROTEUS STEINMETZ.

During this period, too, Mr. Steinmetz worked industriously in the chemical laboratory, and paid attention to mineralogy and other natural sciences, including a casual study of medicine.

At that time, all young Germany was intensely interested in the great problems of national economy which have been coming to the front in the last quarter of a century. Mr. Steinmetz, ever enthusiastic, and with high ideals of ethics in government, became imbued with revolutionary ideas, and even edited for a time a somewhat revolutionary paper which came to an untimely end for lack of the "sinews of war." After what was left of the paper had been confiscated by the government, the editor drifted to Austria, and later to Switzerland, and there entered the Polytechnical School at Zurich, and took up the study of mechanical engineering. He then made a short visit to France, and thence in 1889 came to America, where he settled down to apply the knowledge which he had acquired through so long and active a period of student life.

He first connected himself with the Eickemeyer Company, in Yonkers, N. Y., and remained there four years, filling the period with scientific investigations of rare value, in which he says, with characteristic modesty, that he was greatly assisted by the personal cooperation of Mr. Eickemeyer. At the end of this time, he left with regret his first American home in Yonkers, and joined the forces of the General Electric Company, at Lynn, Mass.

Mr. Steinmetz's writings have been of a very varied and interesting character, as might be imagined from the wide range of his studies. Much of his work has been in pure mathematics, and is consequently less known to the electrical fraternity than some of his later researches. Among his various works may be mentioned a popular hand-book of astronomy, published in Germany in 1888, and various articles to the "Theory of Synthetical Geometry;" "On Twisted Curves," contributed to the American Journal of Mathematics, and divers researches on pure mathematics, contributed to the "Zeitschrift fur Mathematic und Physik."

Most of Mr. Steinmetz's electrical work has been published since his arrival in this country, so that we may be proud to reckon him as being, to all intents and purposes, an American electrician, as he surely is in spirit.

As to his most important electrical researches, we mention "The Theory of the Alternate Current Transformer," three elaborate and valuable papers on "The law of Hysteresis," comprising the results of nearly two years of careful investigation, and presented to the American Institute of Electrical Engineers; a paper on the "Disruptive Strength of Dielectrics," and a large number of minor papers on dielectric hysteresis, inductance and kindred subjects.

Perhaps the most important of all his contributions to literature was a very complete and beautiful study of the application of the vetor analysis as expressed in complex quantities to problems of alternating current work. This was read before the International Electrical Congress in Chicago, 1893, and has since been expanded into a formal treatise on the subject, which will soon be published.

As a practical electrician Mr. Steinmetz is a most expert and intelligent designer of both direct and alternating current machinery, and is well equipped and ready for the solution of every sort of problem which comes before the modern electrical engineer. It may be truly said of him that he has not an enemy in the world, and that every one who is brought into personal communication with him feels toward him the strongest feelings of friendliness—even those who have suffered at his hands in debate; at which, as the members of the American Institute of Electrical Engineers well know, he is most expert. Much as all those who have read his papers respect him by reason of his ability, still more do those who have known him admire the gentle and kindly spirit of the man.

Meeting of the Union of German Electricians.

(From our special Correspondent.)

The second annual general meeting of the Verband Deutscher Elektrotechniker, or Union of German Electricians, took place at Leipzig between the 7th and 9th of June.

The meeting was formally opened on June 8 by Baurath Stübben, of Cologne. After several addresses of welcome had been read in the name of the city of Leipzig and its technical societies, the electrical exhibition that had been formed in connection with the occasion was opened by the honorary president, Privy Councillor Prof. Dr. G. Wiedemann. A round of inspection was then made of the exhibition. The rest of the day was devoted to a dinner, attended by all the delegates to the meeting, and to the reading of papers. On Saturday, June 9, the business discussions came on, under the presidency of Prof. Dr. Slaby. The proceedings began with the presentation by the secretary, Herr Sluzewski, of the general report for the past year and the estimate of expenditures for the year 1894-95. This was followed by discussion of the new regulations. The organization is to be known henceforth as the "Verband Deutscher Elektrotechniker," with headquarters in Berlin, and its business to be conducted by a secretary general, to which office Mr. Gisbert Kapp, so well known in the electrical field, was elected. Several papers were then read, one of the most interesting of which was by Prof. Dr. Budde, on the influence of electric tramway currents on institutes for physical research. Prof. Kohlrausch and Prof. Wiedemann engaged in the discussion which followed. All were of opinion that these institutes should be subordinate to the requirements of traffic, and that if it was necessary for the carrying on of scientific investigations to have the surroundings absolutely quiet and uninfluenced by extraneous currents, such establishments should be situated away from the town.

A report was also read by Prof. Dr. Budde on the position to be taken by the union in respect to the proposed industrial exhibition in Berlin in 1896 Dr. Budde urged that they should abide by the

decision come to at the Cologne meeting last year, viz.: That light and power should only be supplied against payment, a syndicate being formed for the purpose amongst the members of the union, under the direction of a special committee, in order to secure fair terms and division of the work. Similar action was proposed with regard to the forthcoming exhibition at Karlsruhe.

The exhibition in connection with the meeting at Leipzig, to which reference has been made above, contained nothing specially new. Small types of dynamos and motors were shown, mostly by local firms. The motors were applied to workshop tools, pumps, printing presses, etc. They were all of the two-pole type, rather large in relation to their capacity, and ran at very high speeds, so that countershafting was employed in every case. Messrs. Siemens & Halske had some small dynamos, which, however, were not in operation. There was one novelty in the shape of an instrument for testing different qualities of iron, constructed by Dr. Kupsel and described some little time ago in the Electrotechnische Zeitschrift. The Allgemeine Elektricitaets-Gesellschaft, of Berlin, had installed two induction motors and a stationary transformer, but these were not in operation either. Their exhibit included further an electric meter, with pendulum and automatic winding arrangement, an invention of Hefner-Alteneck. The apparatus was shown at the World's Fair. Several types of the well-known Aron meter were also on view. Mention should be made of an 8-h. p. horizontal steam engine by Ducommun, of Mulhouse, Alsace-Lorraine, which made 400 revolutions per minute and ran very quietly, although its regulation under varying load was slow, owing to throttling.

The next general meeting of the Union of German Electricians will be held at Munich in 1895.

Berlin, June 16, 1894.

Laboratory Notes.—XIX.

BY LIEUT. F. JARVIS PATTEN.

AN EXPERIMENT THAT FAILED.

Many experiments, and sometimes mere trials of plans that on the surface appear to be not only good, but practical, inventions, fail to give the results expected, and prove a source of vexation and disappointment to the person who gives time and money to the investigation. I have known quite a number of such cases of rather unusual interest, some of my own contrivance and some that others have gained dearly-paid experience from and then invited me to tell them why their scheme would not work. It would be really a good thing if all such experiments, however unsuccessful, were described. Many an inventor and experimenter would be saved both disappointment and expense could he be shown that there was no reasonable expectation of success in a work he was about to undertake, or that the scheme had been tried on the intended, and had failed.

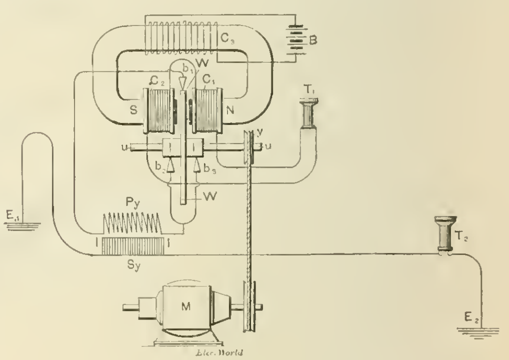
The experiment described here is selected from a number of interesting cases that I have witnessed, and I consider it interesting because I cannot give a reason entirely satisfactory to myself why the plan should not work. Yet it was carefully tried with many modifications, and all without encouraging results.

Though the object in view—namely, to make a "telephone repeater" was a rather ambitious one, the particular plan upon which it was attempted to solve the problem, as well as the underlying principles of the solution, were comparatively simple, and seem almost certainly operative on paper. The general plan was simply this: A telephone transmitter, no matter what the form, so far as this description is concerned, generates a current that goes to line. It is, of course, a very weak current, but there is some, and sensitive apparatus like a telephone receiver (Bell magneto) is variably magnetized by such a current, and its energy is retransformed to mechanical energy in the moving diaphragm and given to the ear as waves of sound. The energy of the current must, however, produce magnetism to do this, and in producing magnetism it certainly creates a magnetic field, varying in strength directly as the current. It produces then an alternating magnetic field, and an armature revolved in such a field should generate an alternating current having an impressed electromotive force that follows in period or rate, and intensity or amplitude the fluctuations of the field magnetism produced, say, by the current from a distant telephone transmitter to which words were spoken. That is to say, it was designed to use a telephone current as a separate excitation of the field of a very small dynamo, the armature of which was to be driven by independent power in the usual way.

Such an armature should yield an alternating current similar to the telephone current, but of greatly increased intensity, because we have a new source of power.

It would be a very inefficient dynamo on which 15 per cent. to 20 per cent. of its entire output were used for field excitation. In this case the telephone current is used; the separate field-exciting current of the dynamo and the armature is driven by independent power external to the system. We should, therefore, expect an armature current of far greater strength than the original telephone current. In other words, the armature should reproduce the telephone current accurately, so far as its fluctuations are concerned, but of far greater intensity. We should, therefore, have in such a machine a telephone current amplifier or multiplier, as well as a mere repeater, and if this were found true for one machine, the new current could be used to excite the field of another, and so on until the current were increased to any desired limit. Evidently this could not, however, be carried very far, as there is undoubtedly a tendency in such continued transformations to bring the alternating current wave to a pure sine form, which would eventually destroy the delicate superimposed fluctuations of the telephone current.

The general plan is shown by a diagram (Fig. 1), which gives the operative parts and circuits. T_1 is a telephone transmitter. Its line goes to the field coils, C_1, C_2, of the field magnet, N S, the air gap between the poles of which was less than an eighth of an inch. The coils, C_1, C_2, were ordinary telephone coils, their resistance in series being about 80 ohms of No. 32 magnetism, or about the same as a telephone receiver. The field magnet, N S, was a round bundle of very soft annealed iron wire, the entire magnetic circuit being about six or seven inches long. A battery, B, with its circuit, C_3, coiled about the yoke of this magnet, was used with a variable resistance to give the field, N S, a sufficient degree of magnetization to bring the iron to the point of maximum



TELEPHONE REPEATER.

permeability—where it would, in fact, be most susceptible to very slight changes of field currents, such as those received from the telephone transmitter. In the field, N S, was placed an armature consisting simply of a thin disc of silver, with brushes bearing at the periphery, b_1, and at the spindle, b_2, b_3, thus completing a very small and simple form of unipolar dynamo of the Barlow wheel or Faraday disc type. This armature could be driven at any desired speed up to 12,000 revolutions a minute by an electric motor, M.

Of course, the voltage given by such an armature, having practically but a single turn of wire, would be exceedingly low, no matter what the speed or the field excitation. But as it revolves in a variable or alternating field, it must necessarily yield an alternating current, and, therefore, by connecting a circuit from its brushes to the primary, Py, of a transformer or induction coil, the voltage could be raised to any desired value in a secondary, Sy, which latter circuit was connected to a line with a telephone receiver, T_2, at the distant end. It may be well to explain why a unipolar machine was first selected for this experiment, instead of some other direct current type of drum or ring armature capable of generating a higher voltage.

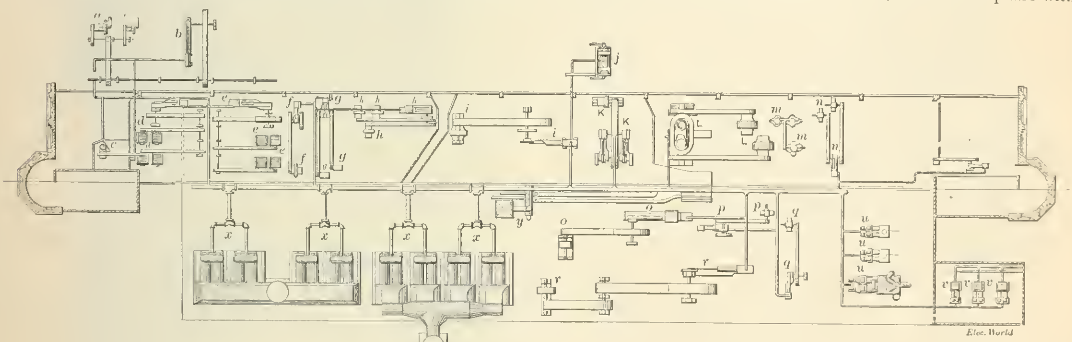
The reason is that most any such armature, having a commutator, must necessarily produce a fluctuating current—as, for instance, when the brushes of such an armature bear on two consecutive commutator segments, two coils of the winding (meaning many turns) are cut out of circuit, and when they are each on a single segment these coils are in circuit again. This changing resistance causes all such armatures to yield a fluctuating current, which would destroy the delicate fluctuations of the telephonic current. The unipolar, or disc machine, on the contrary, yields at a constant

speed a perfectly smooth and uniform current as long as the field is constant, and if this is altered the current in the armature must follow the fluctuations of the field. The disc machine as described, which was probably the smallest unipolar machine ever built, was tried under a great variety of conditions, but without encouraging results, and I am at a loss to say definitely what the trouble was. The machine generated current, but the telephone in the secondary circuit of the induction coil, I, gave no response.

A Gramme ring armature that gave a perfectly smooth current, without fluctuations of any kind, was then devised, built and substituted for the disc. Its construction, being novel, deserves description. A soft iron wire ring (core of the armature) was encased in fibre, and in a miller, 240 slots, large enough to take a No. 18 wire, were cut on both the inner and outer periphery. The core was then covered with a single layer of 240 turns of bare copper wire, each turn being thus air spaced from its neighbor, and the brushes were arranged to run on the bare wire. Thus, each single turn of wire was its own commutator segment, and the amount of wire cut in and out as the brushes would bear first on one and then on two turns would only be the half of a single turn, but the brushes were made so as to extend over three or more turns, so that there was always the same amount of wire in the armature circuit, and a current free from any fluctuations could be obtained; and this was proven by the failure of the telephone to give any sound when connected in the armature circuit. The results were not more promising with this armature than with the disc pattern.

The Power Plant of the Midwinter Fair.

We present herewith a plan of the power plant of the California Midwinter Exposition, from which the arrangement of the machinery will be apparent. The original plan was to have all the engines



PLAN OF POWER PLANT OF THE MIDWINTER FAIR.

in line parallel to the boilers and as near the back walls of the building as possible, all belts running parallel and the dynamos placed in line under the break of the gallery. The miners' exhibit, however, was allotted space which interfered with this and necessitated a change in the plans. Furthermore, the dynamos are all operative exhibits, and it was desirable to concentrate the displays of the various companies as far as possible. Considering the number of belts necessary, it would perhaps appear that it might be difficult to move about in the plant, but the arrangement is such that any point can easily be reached.

Inductance of Lines.

BY G. M. WARNER.

Having repeatedly found occasion in the calculating of lines for alternating current power transmission to use the inductance of one wire on the other, which as we know appears as a loss of voltage by increase in the apparent resistance of the line, and never finding a table embodying just what I wanted, I calculated some time ago an extra column to my wire table.

The formula used is one which can readily be found in text books:

$$L = .5 + 2 \log \frac{d}{r}$$

where d is the distance between the wires and r is the radius of the wire, both being expressed in the same units, and L is the coefficient of self-induction per centimetre of wire, expressed in centimetres. Hence, for the table where I have used millihenrys per mile, the formula becomes:

$$.1609 \left(.5 + 2 \log \frac{d}{r} \right)$$

Size of wire. B. & S.	Resistance per mile. 15.5° C.	Inductance in millihenrys per mile for d = 8″	12″	16″	20″	24″
0000	.259	1.22	1.35	1.44	1.52	1.57
000	.324	1.26	1.39	1.48	1.56	1.61
00	.412	1.30	1.43	1.52	1.59	1.64
0	.519	1.34	1.47	1.56	1.63	1.68
1	.655	1.37	1.50	1.60	1.67	1.72
2	826	1.41	1.54	1.63	1.71	1.76
3	1.041	1.45	1.58	1.67	1.74	1.79
4	1.313	1.49	1.61	1.71	1.78	1.83
5	1.656	1.52	1.65	1.75	1.82	1.87
6	2.088	1.56	1.68	1.78	1.85	1.91
7	2.633	1.60	1.72	1.82	1.89	1.94
8	3.320	1.63	1.76	1.86	1.93	1.98
9	4.186	1.67	1.80	1.90	1 97	2.02
10	5.280	1.71	1 83	1.93	2.00	2.06

Tables have been published giving impedance factors of wires at various distances and cycles, and perhaps a few examples of the difference between these tables and the above will be of interest.

I will take a case where we have a line, say one mile long, with 1,000 volts and 50 amperes at the receiving end, and work out the voltage required at the generator under various conditions, supposing the line to be of No. 3 B. & S. wire and 12″ apart, using 125 cycles per second.

No. 3 wire has a resistance of 1.04 ohms per mile, and, from the table, an inductance of 1.57 m. p. per mile at 12″ apart.

The resistance drop. for the two miles of wire is $50 \times 2 \times 1.04$ volts, and the inductance drop equals $2 \pi n L C 10^{-3} = 2 \times 3.14 \times 125 \times 1.57 \times 10^{-3} \times 2 \times 50 = 107.5$ volts, but is not in phase with the resistance drop, differing by 90 degrees; compounded by the law of resultant forces, the total drop would be

$$\sqrt{104^2 + 107.5^2} = 149.5 \text{ volts, or } 74.8 \text{ volts per wire.}$$

From a table of impedance factors we would obtain for these same conditions 1.44, giving as the drop $1.04 \times 1.44 = 149.5$, the same as before; but what I wish to show is that, while this drop does actually occur, it may not necessarily be in phase with the line potential, and hence will not appear as a loss of voltage—that is, the difference between the voltage of the dynamo and that received at the end of the line may be less than this drop of 149.5 volts.

First, we will assume that we are feeding a non-inductive load. Here the C R of the load = 1,000 volts, and the total $C R$ = 1,000 + 104= 1104; the inductive drop of the load = 0, and of the line = 107.5; hence the total inductive drop = 107.5 + 0 = 107.5. Combining these by the same method as before gives as the generator potential:

$$\sqrt{1104^2 + 107.5^2} = 1,110.$$

We see in this case that the actual loss in voltage in the transmission is 1,110 — 1,000 = 110, or 39.5 less than the drop simply due to the lack of agreement in phase.

We will take another case where the load is inductive, causing a lag of 46°—that is, its inductive component is 120 volts and its

energy component 696 volts, giving the total voltage of the load still:

$$\sqrt{720^2 + 696^2} = 1{,}000.$$

Then our total C R drop is 696 + 104 = 800 volts, and the total inductive drop = 720 + 107.5 = 827.5, and the generator voltage equals

$$\sqrt{827.5^2 + 800^2} = 1{,}150,$$

giving a loss in voltage of 1,150 — 1,000 = 150, or the same as given by the impedance factors.

Suppose we feed a condenser load having an advance of 46°—that is, an energy component of 696 volts and a wattless component of 720 volts, giving as a resultant:

$$\sqrt{696^2 + (-720)^2} = 1{,}000.$$

Then our total C R drop is 696 + 104 = 800, and the total wattless drop = 720 = — 107.5 = — 612.5, and the resultant E. M. F. at the generator

$$= \sqrt{800^2 + (-612.5)^2} = 1{,}075,$$

giving a loss of voltage of only 75 volts.

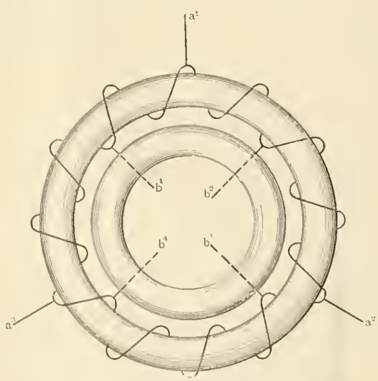
In fact, it is often the case that the E. M. F. at the generator is less than that at the end of the line. The above examples, I think, illustrate the method of calculating lines, which, in a few words, consists of resolving all the various E. M. Fs. and currents into their two components—one the energy and the other the wattless component—and finally combining the sums of these two components by the law of resultant forces. No account is here taken of the extra resistance due to the "skin" effect, for it is usually very slight.

Polyphased Transformation.

To the Editor of the Electrical World:

Recent articles in The Electrical World on the transformation of currents of one phase into currents of another phase have been particularly interesting to me as I had been working on this problem just previous to their publication. Believing that a description of my device may prove of interest at this time, I send the accompanying sketch, which, I think, will nearly explain itself.

Strictly speaking, this is not a transformer, but rather a "translating device," as the current is changed in phase only and there is



Polyphased Transformation.

but one winding on the cores. I take the ordinary ring cores and wind one of them with a single coil, the other core serving to complete the magnetic circuit.

As an example, take a case where a three-phased current is to be converted to one of four phases; the rotary field is produced by the three-phased current connected to the terminals a^1, a^2, a^3, and the four phased current can then be drawn off from the same wire as at terminals b^1, b^2, b^3, b^4.

It is quite evident that with this device currents of any phase whatever can be changed to any other phase.

Johnstown, Pa. BRUCE FORD.

Photographing a Lightning Bolt.

The accompanying illustration is taken from a photograph made by an amateur, Mr. W. B. Getchell, of Augusta, Me., during an electrical storm in that vicinity. The bolt seemed to go across the heavens in an irregular line, until reaching a point at about the center of the top of the illustration, when it took an almost perpendicular course to the earth, where it struck at a point about a quarter of a mile distant. The white dots in the background are the arc lights on the opposite side of the river. At the time of the

Photograph of Lightning Flash.

exposure everything was in darkness, and the whole illumination came from the lightning flash.

Moonlight Tables for August, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of August under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	7.40 P. M.	2	4.00 A. M.	1	7.40 P. M.	2	4.00 A. M.
2	7.40 "	3	4.00 "	2	7.40 "	3	4.00 "
3	7.40 "	4	4.00 "	3	7.40 "	4	4.00 "
4	7.40 "	5	4.00 "	4	7.40 "	5	4.00 "
5	7.40 "	6	4.00 "	5	7.40 "	6	4.00 "
6	9.00 "	7	4.00 "	6	7.40 "	7	4.00 "
7	9.20 "	8	4.00 "	7	7.40 "	8	4 00 "
8	9.50 "	9	4.00 "	8	7.40 "	9	4.00 "
9	10.30 "	10	4.10 "	9	7.30 "	10	4.10 "
10	11.10 "	11	4.10 "	10	7.30 "	11	4.10 "
11	12.00 M.	12	4.10 "	11	7.30 "	12	4.10 "
12				12	7.30 "	12	M.
13	1.00 A. M.	13	4.10 A. M.	13	7.30 "	13	"
14	2.00 "	14	4.10 "	14	7.30 "	14	"
15	No light.	15	No light.	15	7.30 "	15	"
16	"	16	"	16	7.30 "	16	"
17	7.20 P. M.	17	8.40 P. M.	17	7.20 "	17	"
18	7.20 "	18	9.00 "	18	7.20 "	18	"
19	7.20 "	19	9.20 "	19	7.20 "	19	"
20	7.20 "	20	9.40 "	20	7.20 "	20	"
21	7.20 "	21	10.00 "	21	7.20 "	21	"
22	7.20 "	22	10.30 "	22	7.20 "	22	"
23	7.20 "	23	11.10 "	23	7.20 "	23	"
24	7.10 "	24	12.00 M.	24	7.10 "	24	"
25	7.10 "	26	12.50 A. M.	25	7.10 "	26	1.00 A. M.
26	7.10 "	27	2.10 "	26	7.10 "	27	1.50 "
27	7.10 "	28	3.20 "	27	7.10 "	28	3.20 "
28	7.10 "	29	4.20 "	28	7.10 "	29	4.20 "
29	7.10 "	30	4 30 "	29	7.10 "	30	4.30 "
30	7.10 "	31	4.30 "	30	7.10 "	31	"
31	7.00 "	1	4 30 "	31	7.00 "	1	"

Total No. of hours, 162.00.

Note.—These schedules are made up on sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

Central Lighting and Power Stations of Chicago.

BY CHARLES DESMOND.

Chicago is about as well supplied with electric light and power as any city in the United States, a great part of which is furnished from central stations, the largest and most numerous of which are owned and operated by the Chicago Edison Company, which has six separate and distinct stations located in different parts of the city. One of these stations has an annex which contains machinery with a capacity of 600 kilowatts, and another station now being built is to be fitted with the latest improved machines with a total capacity of 8,000 kilowatts.

The Chicago Edison Company commenced business in 1886 with a small station located in a basement and having but small capacity. The service given and the rapidly increasing demand for light soon compelled it to seek larger quarters and install more capacious machines. The station on Adams street, which is now known as Station No. 1, was then erected and equipped with the best machines for the purpose which could be procured.

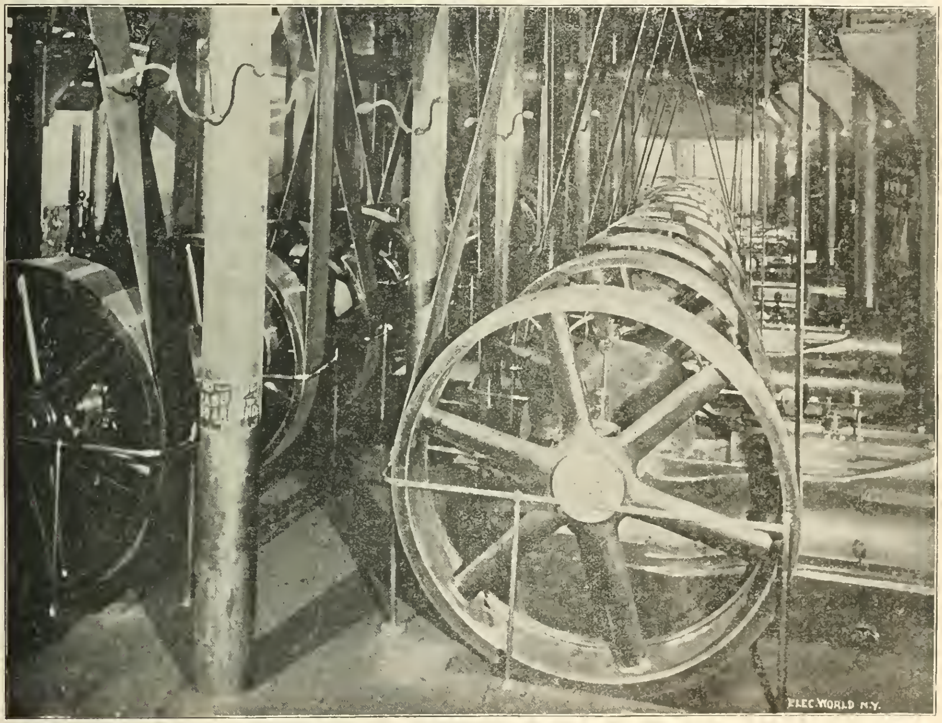
The following named gentlemen are the present officers of the company: Samuel Insull, president; F. S. Gorton, secretary and treasurer; G. H. Wilmerding, general superintendent; W. H. Anthony, comptroller; W. L. Church, superintendent of low tension, and P. L. Kelsch, superintendent of high tension systems; L. A. Furgeson, electrical engineer; R. W. Francis, chief engineer.

Station No. 1 was erected in 1888 near the centre of the business district, and was designed not only for the amount of business that was apparent at the time, but with a knowledge that it would increase considerably, and calculations were made accordingly. The style of the building is ornamental, having an arched front, supported by Corinthian columns, and is built of red, pressed brick, three stories high, with a capacious basement. The frontage is 44 feet, with a depth of 200 feet. The front portion, which contains the offices, store room and testing room, is 26 feet in depth. Back of the offices, on the ground floor, is the engine room, 100 by 44 feet, in which is very compactly installed 16 high-speed engines, consisting of eight Armington & Sims, four of which are 18½ inches by 18 inches and four of 18 inches by 24 inches, two Ideals 18½ inches by 18 inches, four McIntosh & Seymour 18½ inches by 18 inches, and two others of the same make 19 inches by 23 inches, aggregating about 5,500 h. p.

The engine room floor is supported on very heavy iron floor sills, which are laid on the smoothed surface of substantial stone walls, which, in turn, are supported by a solid foundation which is so firm that scarcely a tremor is felt from the movement of the machines when all the engines, and dynamos are in action. This part of the design of this station is especially meritorious, as it is seldom that the operation of so much machinery is carried on so quietly that no noise or vibration is noticeable in adjoining rooms of the same building. This is largely due to the fact that the engine room floor does not touch and is not supported by the side walls.

Directly above the engines are the dynamos, 32 in number, each engine driving two dynamos, one from either fly-wheel, by the use of double leather belts, which incline but a few degrees from the vertical. This style of driving is found most suitable, as the dynamos are run in pairs, on the three-wire system, but are so arranged that any two machines can be operated together, cross-connections being supplied and each machine equipped with reversing switch.

The dynamo plant consists of twenty No. 32 and twelve No. 60 Edison machines, arranged in two rows, the centre line between the rows being directly over the line of the crank shafts of the engines; the engines being set so that the shafts are in line and each alternate engine faces in the opposite direction.



INTERIOR VIEW, CHICAGO EDISON STATION.

The dynamo room, of the same size as the engine room, has a very high ceiling, and the roof is composed almost entirely of heavy plate glass, affording plenty of light during the day and ample ventilation at all times, so that the room is never uncomfortably warm—a feature that is beneficial to the machines as well as to the attendants.

Ranged along one side of the room are the bus bars, to which the machines are connected by heavy copper bars that lead from the machines to the ceiling, then across to the wall and down to the bars. The bus bars are 2½ inches by ½ inch, and are in multiple to a capacity of 25,000 amperes. Above the bus bars are arranged the feeders, supplied with the necessary ammeters and cut-outs, which lead to the centres of distribution about the city, of which there are 36 supplied from this station, some of them being located as far as nine blocks, or more than a mile away. The feeders, after

leaving the dynamo room, are of rubber covered and braided cable to where they enter the subways, which are of the Edison type, consisting of iron tubes containing the insulated wires embedded in insulating composition, composed mainly of asphaltum. Each of the pipes contain two pressure wires in addition to the three wires of that circuit, but the middle, or neutral, conductor is only one-third the sectional area of the others, but is of sufficient size to carry the load that would be thrown on it in case of a break down to one of the other conductors. Each set of pressure wires is fitted with indicators, which are in plain sight at all times and marked with the number of the circuit to which it belongs.

This station supplies current under low tension only, the voltage at the generators being 240 with an average of 230 at the centres of distribution.

All the feeders leave the station on the Adams street side at a depth of eight feet below the surface, but soon rise to within twelve inches of the pavement, being buried at a sufficient depth to escape accidental injury while still being convenient for repairs.

The distribution boxes, which are of the usual Edison type, are located at the street intersections, a few feet from the curb, in the immediate vicinity of the buildings to which current is to be supplied. In some cases the demand for current has been so great that the carrying capacity of some of the circuits, owing to their great length, has been overtaxed; but this difficulty has been overcome by connecting a "boosting" circuit from another station to that particular centre of distribution, thus more nearly equalizing the potential all around.

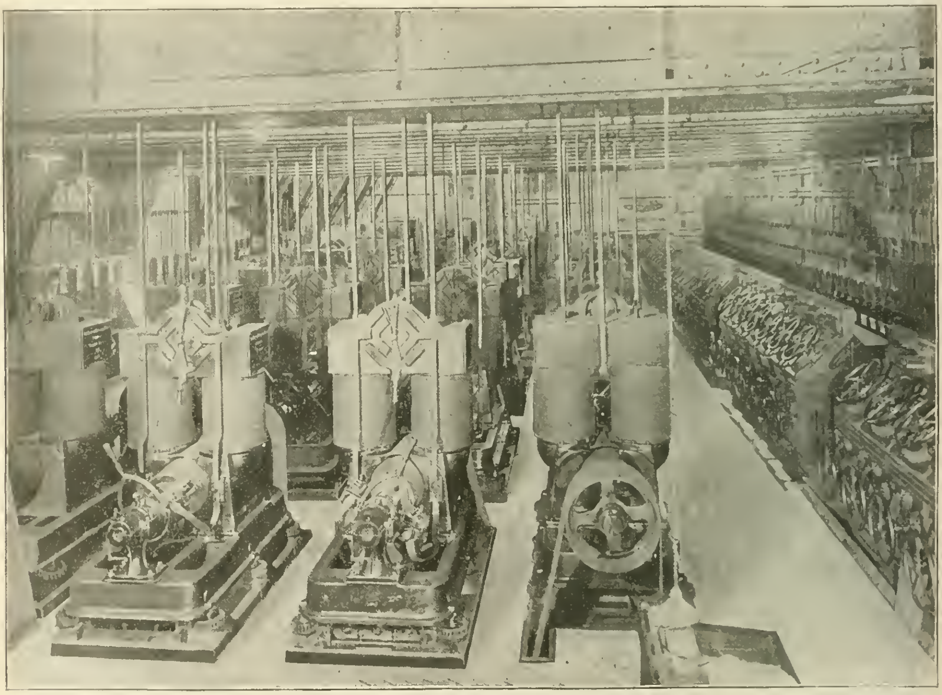
Ten Heine boilers are required for furnishing the steam for this plant. These consist of four of 325 h.p., one of 500 and five of 375 h. p. The boilers are located on two floors, five on each, and each boiler is separately connected to the mains, so that any one can be laid off when desired without interfering with the others. The boiler rooms are each 74 by 44 feet. Two steam pipes, 18 inches in diameter, are arranged so that either or both may be used as the conditions require, and an 8-inch supply pipe connects with each engine.

Hawley down-draught furnaces are used under all the boilers. These are connected with a chimney 150 feet high, which give a draught equal to a pressure of three-quarters inch of water, ample for all the requirements. The down-draught furnaces were put in but a short time ago, a different kind having been previously in use, but constant trouble with the city smoke inspectors made a smokeless furnace necessary.

Coal storage is provided for on the third floor, above the boilers, and has a capacity sufficient for a four days' supply. At the present time the consumption of fuel is at the rate of 110 tons per day of 24 hours, but this is less than the amount that was required during the past winter. The coal is raised to the storage room by electric elevators.

The heating of the building is by the use of exhaust steam, by the Williams system, which provides circulation by pumping out the returns.

City water is used for supplying the boilers, and is partly purified before use by being passed through a 2,000-h. p. Baragwanath heater, where the temperature is raised to about 210 degrees and a portion of the mineral impurities precipitated before it enters the boiler. This heater contains 2,000 square feet of heating surface and weighs 11.5 tons. It is the largest heater built by the Baragwanath Company. There is also a 1,000-h.p. Berryman heater in use in connection with the one described.



INTERIOR VIEW, CHICAGO EDISON STATION.

There are four boiler feed pumps of the Worthington duplex tpye, each being 10 inches by 6 inches by 10 inches.

The engines are all ready for use at a moment's notice, being kept hot by being open to the exhaust when not in use. This precaution is absolutely necessary, for sometimes the load comes on with amazing rapidity, requiring the utmost exertions of the attendants for a few moments, as was the case one day lately when the load increased 8,000 amperes within ten minutes' time. Similar large increases of load within a few minute are not uncommon when thunderstorms are coming up, for then it gets quite dark.

Under the present management the service of this company has been all that could be desired, as there have been but very few interruptions of service from any cause.

The average load of this station during the past winter was 9,000 amperes, supplied mostly to lamps, but the amount used for power purposes has been considerable, as there are 1,500 h. p. of motors attached to the circuits. The motors are used for all conceivable purposes, a number being employed for operating elevators, and

many for driving machinery and hoisting. The maximum load was 19,000 amperes.

A complete set of records of all happenings to the plant is kept in a most systematic manner, and such "troubles" as do occur are attended to without delay, the men for this purpose being on duty or within call at all times, although their services are seldom called for to attend anything of a serious nature. The worst difficulty that has occurred for some time was a slight fire among the cables, one afternoon some weeks ago, when some one without authority turned in the fire alarm. The department responded with their usual alacrity, and before it could be prevented deluged the cables, making things lively for the station men, but not interrupting the service except for a couple of hours. The bravery and energetic actions of our fire departments are well known and commendable, but their knowledge of electricity is not as great as is sometimes desired.

An annex is connected with this station. It contains two Armington & Sims engines, each of 450 h. p., and four No. 60 Edison dynamos, which are kept in continual service to help the main plant. This annex was built in November, 1892, and the installation of the machinery called for the most careful and competent engineering ability, as the only place that could be found for it in that neighborhood was in a basement, just across the alley in rear of the station.

To get the machines into this place required that a portion of the foundation walls of the building be removed. The machines, taken apart as far as was advisable, were first lowered to the tunnel, which had been prepared for the 10-inch steam pipes from the boiler plant, and then passed through on rollers to the position they now occupy. This was a difficult task, as the tunnel was small, and the space that could be utilized no more than required, but the task was finally accomplished without accident.

This station has done good work during its time, but the locality has outgrown its capacity, and it will be discontinued when the new Harrison street station is finished, for the work can be done more economically in the new station with triple expansion engines and latest improved devices than with the engines with which this station is now equipped. The station bus bars are ready for being connected to the 1⅞ inch by 5 inch conductors which lead underground and through the company's private tunnel under the river to the Harrison street station, but as this station will not be ready for some months, the old station will continue its accustomed activity, and be held in reserve for some time.

An Electrically Cooked Banquet.

A banquet was tendered recently in London by Sir David Salomons and the directors of an electric lighting company, in which everything was cooked by electricity; there were 120 guests, and the number of kilowatt-hours used was 60, for cooking ten courses, or one-half a kilowatt-hour per person; this, at the cost of eight cents per kilowatt-hour, which is what that company intends to charge for electricity for cooking purposes, makes the cost of the heat four cents per person for ten courses. The banquet is described in detail by some of our English contemporaries.

Permeability of Steel.

BY MAX OSTERBERG AND MILBOURNE MUNROE.

The samples of steel whose magnetic properties are given in the accompanying curves and tables were generously furnished by the Bethlehem Iron Company, together with a complete chemical analysis of each specimen. The samples are of regular commercial grades, and formed part of the exhibit of this company at the Chicago World's Fair.

The method followed in determining the magnetic properties was that usually known as Hopkinson's. A large forging of the shape and dimensions indicated in Fig. 1 was used, serving as a short-circuiting device for the magnetic lines of force, so that only that length of bar is considered which goes from M to M of the block,

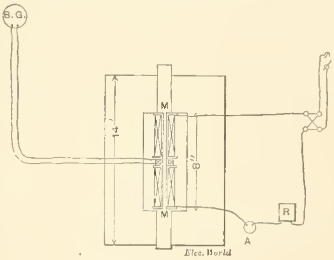


FIG. 1.

which in the present case was eight inches. The coils which served as a primary had first 900, then 2,000 turns, while the current used was varied from .07 to 6 amperes. The secondary, or exploring coil, consisted of 90 turns of small wire wound on a spool of hard rubber. The test pieces were cut in two and joined right at the end of the exploring coil, so that when one part of the piece was pulled away, the exploring coil, being attached to a spring, would fly out. A d'Arsonval ballistic galvanometer, the complete period of which was fifteen seconds, a reversing switch in the primary, which served as an excellent device with which to bring the galvanometer to rest, an ammeter and variable resistances formed the rest of the apparatus.

The experiments were performed as follows: A steady current was passed through the primary, and then the movable piece was pulled out. The exploring coil necessarily cut all the lines of force in flying out, thus generating a current which gave the galvanometer needle a kick. The number of scale divisions multiplied by the

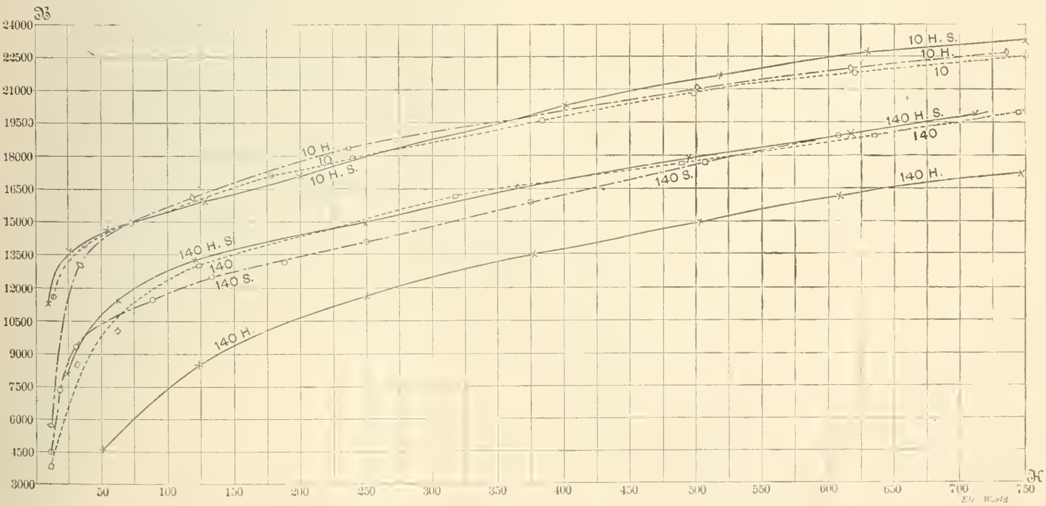


FIG. 2.

galvanometer constant, previously determined, gave then the quantity (Q) of electricity which was induced in the secondary. From the theory of the ballastic galvanometer,

$$\frac{10\ QR}{Z} = \Phi$$

where R = resistance of the secondary circuit;
Z = number of turns of exploring coil;
Φ = flux.

Knowing Φ we can find μ, for

$$\Phi = \frac{4\ \pi\ NC\ 10^{-1}}{\dfrac{l}{s\ \mu}}$$

$$\therefore \mu = \frac{10\ l\ \Phi}{4\ \pi\ NCs}$$

where NC = ampere turns in primary;
l = length of test piece;
s = cross-section test piece.

We can also find $\mathfrak{B}$ from Φ, for $\Phi \div s = \mathfrak{B}$
where $\mathfrak{B}$ = number of lines of force per sq. cm, or gausses;
$\mathfrak{B}'' = \mathfrak{B} \times 6.45$ " " " " inch.

Finally we determine $\mathfrak{H}$, for $\mathfrak{H} = \mathfrak{B} \div \mu$.

The following tables give the results of experiments:

A.—BASIC OPEN HEARTH STEEL COMPOSITION.

Carbon	.07
Manganese	.22
Phosphorus	.008
Sulphur	.032
Silicon	.053

	Annealed, 10 S				Plain, 10			
	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$
1	9,110	1,052	8.67	58,760	11,466	927	124	73,956
2	11,498	929	12	74,162	13,883	362	38	89,546
3	14,626	197	74	94,338	14,721	238	62	94,950
4	15,992	129	124	103,148	16,114	130	124	103,935
5	17,852	72	248	115,145	17,943	72	249	115,732
6	19,526	53	369	126,007	19,616	51	384	126,523
7	21,693	35	620	139,920	21,630	35	618	139,514
8	22,592	30	753	145,718	22,506	30	750	145,164

	Hardened and Annealed, 10 HS				Hardened, 10 H			
	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$
1	11,219	1007	11	72,363	5,422	438	12	34,972
2	13,574	488	28	87,552	13,387	361	37	86,346
3	14,689	237	62	94,744	15,000	20	74	96.750
4	15,371	160	96	99,143	16,177	131	124	104,342
5	16,052	115	139	103,535	18,253	74	247	117,732
6	16,982	85	200	109,534	20,948	42	499	135,114
7	21,631	42	515	139,520	22,066	36	613	142,326
8	23,341	31	753	150,549	22,655	305	743	146,125

B.—ACID OPEN HEARTH STEEL COMPOSITION.

Carbon	1.406
Manganese	.470
Phosphorus	.032
Sulphur	.032
Silicon	.077

	Annealed, 140 S				Plain, 140			
	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$
1	4,401	395	11	28,386	3.946	319	12	25 452
2	7,685	563	21	49,568	8,863	239	37	57,166
3	9,607	265	37	61,965	10,165	164	62	65,564
4	11,403	128	89	73,549	13,078	106	123	84,353
5	12,520	94	133	80,754	15,080	61	247	97,266
6	14,008	56	250	90,351	16,444	44	374	106,064
7	17,757	35	507	114,533	17,665	36	490	113,939
8	18,904	31	610	121,931	20,050	27	743	129,323

	Hardened and Annealed, 140 $\mathfrak{H}$S				Hardened, 140$\mathfrak{H}$			
	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$	$\mathfrak{B}$	μ	$\mathfrak{H}$	$\mathfrak{B}''$
1	7,996	323	25	51,574				
2	11,498	186	62	74,162	4,550	92	49	29,348
3	13,203	107	124	85,159	8,554	69	124	55,173
4	14,972	60	250	96,569	11,682	47	249	75,349
5	16,735	45	372	107,941	13,426	36	373	86,598
6	17,807	36	495	114,855	15,060	30	502	97,137
7	19,090	31	616	123 131	16,152	26	621	104,180
8	20,203	27	748	130,309	17,231	23	749	111,140

The curves in Fig. 2 represent only two different qualities of steel, each of which was treated in four different ways. Seven distinct curves were obtained, some entirely different at low points of saturation and intersecting at somewhat higher points. These two qualities furnish ample proof of the fact that all curves used nowadays—that is, those to which the general public has access—are almost useless. There is at least as large a difference in different makes of wrought iron as in steel, and, therefore, to use a conventional curve which happens to be found in textbooks is not only very unscientific, but it is also misleading and inaccurate. Prof. Ewing states: "At every stage the susceptibility and permeability are less in steel than in iron," but this is in practice by no means the case. Of course, if a good quality of wrought iron is compared with a poor quality of steel this will be true, but it is safe to say that a great deal of the wrought iron used commercially is less impure than the quality of steel (No. 10) tested. In a paper read at the Chicago meeting of the American Institute of Electrical Engineers by Messrs. Thompson, Knight and Bacon, a number of cast steel curves are to be found which intersect the conventional Hopkinson wrought iron curve and those of wrought iron samples tested by these gentlemen themselves. This phenomenon may be due to the chemical constitution of the specimens tested, as the impurities in wrought iron are not as deleterious at lower saturations as at high ones, while in steel the reverse might be true.

In the course of experimenting it was invariably found that, the softer the steel, the more difficulties were encountered in getting satisfactory results. A little heating at the end of the test pieces would make quite a marked difference, while in the hard steel it was comparatively easy to get good results. Mild steel is probably more susceptible to magnetic influences, and any slight variation might have considerable bearing. It might be said that mild steel is in a kind of unstable equilibrium.

Practical Notes on Dynamo Calculations. IX.

BY ALFRED E. WIENER.

b.—Radiating Surface of Ring Armatures.

In ring armatures the construction and mounting of the core may be such that either one, two, three, or all four sides of the cross section are in contact with the air, but in modern machines, almost

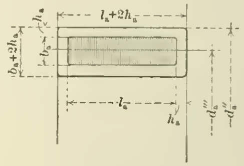


FIG. 20.

without exception, all four, or at least three, of the surfaces constituting the ring are radiating areas (Fig. 20).

In the first mentioned case (four sides) we have the formula:

$$O_a = 2 \times d'''_a \times \pi \times (l_a + b_a + 4 \times h_a), \tag{45}$$

and in the latter case (three sides):

$$O_a = d''_a \times \pi \times (l_a + 2\ h_a) + 2 \times d'''_a \times \pi \times (b_a + 2\ h_a) \tag{46}$$

O_a = radiating surface of armature, in square inches;
d''_a = external diameter of armature, in inches;
d'''_a = mean diameter of armature core, in inches;
l_a = length of armature core, in inches;
b_a = radial depth of armature core, in inches;
h_a = height of winding space, in inches.

18.—Specific Energy Loss. Rise of Armature Temperature.

While the amount of the consumed energy, W'_a, formula (42), determines directly the quantity of heat generated in the armature, the amount of heat liberated from it depends upon the size of its radiating surface, upon its circumferential velocity, and upon the ratio of the pole area to the radiating surface.

The most important of these factors in the heat conduction from an armature naturally is the size of the radiating surface, while the speed and the ratio of polar embrace are of minor influence only; and it is, therefore, the ratio of the energy consumed in the armature to the size of the cooling surface, that is, the *specific energy loss*, which limits the proportion of heat generated to heat radiated, and which consequently affords a measure for the degree of the temperature increase of the armature.

A. H. and C. E. Timmermann,* of Cornell University, who made the armature radiation the subject of their paper read before the American Institute of Electrical Engineers, in May, 1893, from a series of elaborate experiments drew the following conclusions:

(1.) An increase of the temperature of the armature causes an increased radiation of heat per degree rise in temperature, but the ratio of increase diminishes as the temperature increases, and an increase of the amount of heat generated in the armature increases the temperature of the armature, but less than proportionately.

(2.) As the peripheral velocity is increased, the amount of heat liberated per degree rise in temperature is increased, but the rate of increase becomes less with the higher speeds.

(3.) The effect of the field poles is to prevent the radiation of heat; as the percentage of the polar embrace is increased, the amount of heat radiated per degree rise in temperature becomes less.

*A. H. and C. E. Timmermann, Transactions Am. Inst. of Elec. Eng., Vol. X., p. 336. (1893.)

Combining these results with the data and tests of various dynamos, the author finds the following values given in Table XXX of the temperature increase per unit of specific energy loss, that is, for every watt of energy dissipated per square inch of radiating surface, under various conditions of peripheral velocity and polar embrace:

TABLE XXX.—SPECIFIC TEMPERATURE INCREASE IN ARMATURES.

Peripheral velocity in feet p. sec.	Rise of temp. per unit of specific energy loss, in degrees Centigrade, τ_a						
	Ratio of pole area to total radiating surface.						
	.8	.7	.6	.5	.4	.3	.2
0	110°	100°	95°	90°	86°	83°	80°
10	80	74	70	67	64	62	60
20	64	61	58	56	54	52	50
30	55	53	51	49½	48	46½	45
40	50	48½	47	46	45	44	43
50	48	47	46	45	44	43	42
75	47	46	45	44	43	42	41
100	46	45	44	43	42	41	40
150	45	44	43	42	41	40	40

In Fig. 21 these temperatures are represented graphically; Curves I., II. . . . . VII., corresponding to Columns 2, 3 . . . 8, of Table XXX., respectively.

Multiplying this specific temperature increase by the respective

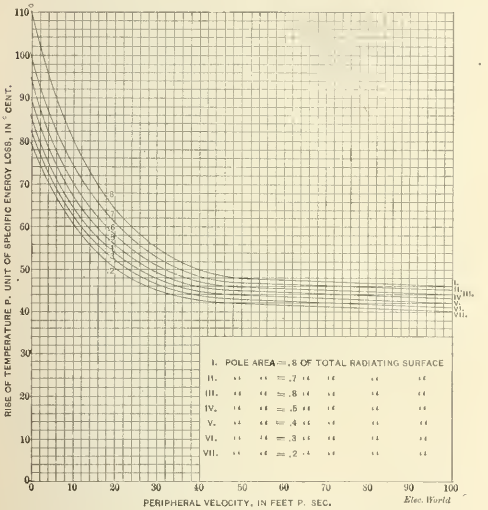


FIG. 21—SPECIFIC TEMPERATURE INCREASE IN ARMATURES.

specific energy loss, the rise of temperature in any armature can be found from:

$$t_a = \tau_a \times \frac{W_a}{O_a} \qquad (47)$$

where: t_a = rise of temperature in armature, in degrees Centigrade;

τ_a = specific temperature increase, or rise of armature temperature, per unit of specific energy loss, from Table XXX. or Fig. 19;

W_a = total energy consumed in armature, in watts, formula (41);

O_a = radiating surface of armature, in square inches, from formula (44), (45) or (46) respectively;

$\frac{W_a}{O_a}$ = specific energy loss, *i. e.*, watts energy loss per square inch of radiating surface.

Empirical Formula for Heating of Drum Armatures.

From tests made with drum armatures, Ernst Schulz† derived an empirical formula, which, when translated into our symbols and units, becomes:

$$t_a = .00045 \times \frac{\mathfrak{B}_a \times P \times N \times M}{O_a} \qquad (48)$$

t_a = rise of armature temperature, in degrees Centigrade;

$\mathfrak{B}_a$ = magnetic density in armature body, in lines per square inch;

P = number of pairs of magnet poles;

N = Number of revolutions per minute;

M = mass of iron in armature core, in cubic feet;

O_a = armature surface, in square inches. (In his calculations, Mr. Schulz, for convenience, takes the external surface of the cylindrical part, $d''_a \pi \times l_a + \frac{d''^2_a \times \pi}{2}$, instead of the radiating surface proper, formula (44), but no fault arises from this, as the constant takes care of the difference.)

The numerical factor depends upon the units chosen, upon the ventilation of the armature, upon the quality of the iron, and upon the thickness of the lamination, and consequently varies considerably in different machines. For this reason, it is advisable not to use formula (48), except in case of calculating an armature of an existing type for which this constant is known by experiment. In the latter case, Schulz's formula, although not as exact, is even more convenient than the direct equation (47), which necessitates the separate calculation of the energy losses, while (48) contains the factors determining these losses, and therefore will give the result quicker, provided that the numerical factor has been previously determined from similar machines. For various drum armatures experimented upon by Mr. Schulz, the constant varied between .0003 and .0005, and averaged about .00045.

19. Circumferential Current Density of Armature.

An excellent check on the heat calculation of the armature, and in most cases all that is really necessary for an examination of its electrical qualities, is the computation of the circumferential current density of the armature. This is the sum of the currents flowing through a number of active armature conductors corresponding to unit length of core-periphery, and is found by dividing the total number of amperes all around the armature by the body circumference:

$$J = \frac{K \times \frac{C}{2P}}{d_a \times \pi} \qquad (49)$$

J=Circumferential current density, in amperes per inch length of core-periphery;

K=Total number of armature conductors, all around periphery;

C=Total current generated in armature, in amperes;

$2P$=Number of electrically parallel armature portions (number of poles);

$\frac{C}{2P}$= Current flowing through each conductor, in amperes;

$K \times \frac{C}{2P}$= Total number of amperes all around armature; this quantity is called "Volume of the armature current," by W. B. Esson, and "circumflux of the armature," by Silvanus P. Thompson;

d_a = diameter of armature-body, in inches; in case of a toothed armature, on account of the considerably greater winding depth, the external diameter, d_a'', is to be taken instead of d_a, in order to bring toothed and smooth armatures to about the same basis; for a similar reason, for an inner-pole dynamo, the mean diameter, d_a''', should be substituted for d_a.

By comparing the values of J found from (49), with the average given in the following Table XXXI. the rise of the armature temperature can be approximately determined, and thus a measure for the electrical quality of the armature be gained. The quality of the proportion between the armature winding and the dimensions of the core is indicated by the amount of increase of the armature temperature. If the latter is too high, it can be concluded that the winding is proportioned excessively, and either should be reduced or divided over a larger armature surface.

TABLE XXXI.—RISE OF ARMATURE TEMPERATURE, CORRESPONDING TO VARIOUS CIRCUMFERENTIAL CURRENT DENSITIES.

Circumferential Current Density.	Rise of Armature Temperature.	
	High-speed (belt-driven dynamos.	Slow-speed direct-driven) dynamos.
50 to 100	15° to 25°C	10° to 20°C
100 " 200	20 " 35	15 " 25
200 " 300	30 " 50	20 " 35
300 " 400	40 " 60	25 " 40
400 " 500	50 " 70	30 " 45
500 " 600	60 " 80	35 " 50
600 " 700	70 " 90	40 " 60
700 " 800	80 " 100	50 " 70

† Ernst Schulz, "*Elektrotechn. Zeitschr.*," Vol. XIV., p. 367 (June 30, 1893). "THE ELECTRICAL WORLD," Vol. XXII, p. 118 (Aug. 12, 1893).

The difference in the temperature-rise at same circumferential current density for high speed and low speed dynamos (Columns 2 and 3 respectively, of the above table) is due to the fact that, other conditions being equal, in a slow speed machine less energy is absorbed by hysteresis and eddy currents; that, consequently, less total heat is generated in the armature, and, therefore, more cooling surface is available for the radiation of every degree of heat generated.

20. Load Limit and Maximum Safe Output of Armatures.

From Table XXXI also follows that, according to the temperature increase desired, the load carried by an armature varies between 50 and 800 amperes per inch of circumference, or between about 150 and 2,500 amperes per inch of armature diameter. As a limiting value for safe working, Esson* gives 1,000 amperes per inch diameter for ring armatures, and 1,500 amperes for drums. Kapp† allows 2,000 amperes diametral current density for diameters over 12 inches as a safe load.

Taking 1,900 amperes per inch diameter (= 600 amperes per inch circumference) as the average limiting value of the armature-load, corresponding to a temperature rise of about 70 to 80 degrees Centigrade (see Table XXXI), we have:

$$K \times \frac{C}{2P} = 1{,}900 \times d_a\,, \qquad (50)$$

and since, for the output of a dynamo we can write (see Part II., chap. 1.)

$$W = E \times C = \frac{K \times \Phi \times N}{P \times 10^8 \times 60} \times C\,, \qquad (51)$$

in which

W = The output of dynamo, in watts;
E = Total E. M. F., generated in armature, in volts;
C = Total current, " " " " amperes;
K = Number of armature conductors;
Φ = Number of useful lines of force;
N = Speed in revolutions per minute;
P = Half number of parallel armature-circuits (number of pairs of poles);

We obtain for the limit of the output, by inserting (50) into (51):

$$W = \frac{1{,}900 \times d_a \times \Phi \times N}{10^8 \times 30} = \frac{63 \times d_a \times \Phi \times N}{10^8} \qquad (52)$$

But the useful flux, Φ, is the product of gap area and field-density, or

$$\Phi = \frac{d_a \times \pi}{2} \times \beta', \times l_a \times \mathcal{H},$$

and, consequently, (52) becomes

$$W = \frac{63 \times d_a \times \frac{d_a \times \pi}{2} \times \beta' \times l_a \times \mathcal{H} \times N}{10^8}$$

$$= d_a^2 \times l_a \times \beta' \times \mathcal{H} \times N \times 10^{-6}; \qquad (53)$$

W = Maximal safe output of armature, in watts;
d_a = Diameter of armature core, in inches;
l_a = Length " " "
β' = Percentage of useful gap-circumference; to be taken somewhat higher than percentage of polar arc, to allow for circumferential spread of the lines of force, see table XXXII.
$\mathcal{H}$ = Field density, in lines of force per square inch;
N = Speed in revs. per minute.

Average values for β' taken from practice, are given in the following table:

TABLE XXXII.—PERCENTAGE OF EFFECTIVE GAP CIRCUMFERENCE FOR VARIOUS RATIOS OF POLAR ARC.

Percentage of Polar Arc. β	Percentage of Effective Gap Circumference, β'			
	2 poles.	4 to 6 poles.	8 to 12 poles.	14 to 30 poles.
1.00	1.00	1.00	1.00	1.00
.95	.98	.97	.965	.96
.90	.96	.94	.93	.92
.85	.94	.905	.89	.88
.80	.91	.87	.85	.84
.75	.88	.835	.815	.80
.70	.85	.80	.78	.76
.65	.82	.765	.74	.72
.60	.78	.73	.70	.68
.55	.74	.69	.665	.64
.50	.70	.65	.625	.60

(*To be Continued.*)

* Esson, Journal I. E. E. XX. p. 142. (1890.)
† Kapp, S. P. Thompson's Dynamo Electric Machinery, 4th Ed. p. 439.

Economical Steam Engines and Wasteful Boilers.

According to Mr. Rosenthal, one of the speakers in the discussion on Mr. Crompton's recent paper, says the London *Electrical Review*, Lancashire boilers in Lancashire factories only give an evaporation of 6 to 7 lbs. per pound of coal. Now the ordinary Lancashire factory, with compound steam engines, secures a horse power hour for 1¾ lbs. of coal, from which it follows that compound engines use only 10½ to 12 lbs. of steam per horse power hour. If, therefore, Mr. Rosenthal be correct, it would be found possible, by the exercise of that "great skill and unwearying attention" spoken of by Mr. Crompton, to get 1 horse power hour from only about 6 lbs. of steam. Mr. Rosenthal shouldmake further inquiries into the practice of the ordinary co-operative concerns in coal consumption, for his figures won't stand criticism. He also make thefurther error of classing Lancashire water-tube and ordinary tubular boilers on the same plane, as regards smoke prevention. Now there is absolutely no similitude whatever. The water-tube boiler resembles the upright boiler in these respects, for in both the flames and gases from the furnace rise vertically from the fire surface, whereas in the Lancashire, the marine, the underfired, and similar furnaces the gases sweep along the fire surface and mingle at one common area over the bridge, and it is just this important difference that non-experts entirely overlook. Take, for example, the locomotive boiler without a brick arch, and where can there be found a boiler that produces smoke so freely? The furnace is of the same class as that of the vertical or water-tube boiler. Add the brick arch, and at once there is introduced an entirely different regime, for the brick arch gives in effect the common commingling point of the flue boiler, and smokelessness results.

In Broadbent's modification of the vertical boiler, an immense improvement is effected as regards smoke, simply because the above principle is carried into effect. The Lancashire and marine boilers are correct in form for smoke prevention, but they are wrong in material, for they have water-cooled combustion boxes. The ideal boiler, so far as we can read the results of practice, is one with the whole, or a great part, of its furnace lined with firebrick, and with Serve ribbed tubes beyond the flaming point. Experience alone could decide how far to carry the brick lining, but from the fact that even now, with care, Lancashire boilers are smokeless, it is only a matter of adding a margin to cover the mistakes of the fireman. If makers of water-tube boilers could divorce their minds from the vulgar error that a furnace must be hugged by cold surfaces, and would redesign their boilers on sounder lines, they would probably beat the Lancashire boiler at all points except that of steady steaming, which they could only secure by adding to their water capacity, and the power to use dirty water, when this is compulsory. Unless they do this, they will continue to demand costly smokeless fuel, which is of all fuels most distant from the majority of the power-using centers of this country.

It will be noted that, while Mr. Crompton has said much on the subject of forcing boilers, he has, even in his corrected reply, not given a single figure bearing upon the rate of fuel combustion per foot of grate. Vague generalities about doing 50 per cent. beyond its normal power tell nothing. The normal horse power of a Babcock boiler is based on 30 lbs. of steam per horse power hour; put such a boiler to drive a 15-lb. engine, and at once it is doing 100 per cent. beyond its normal.

It is simply begging the question to omit the amount and rate of coal consumption when bragging about results in forcing a boiler. Rated horse power is simply a later form of the old nominal horse power—utterly valueless. Of what possible good can it be to talk in one breath of a boiler horse power which means 30 lbs. steam and a Willans, Sulzer or other modern engine horse power which means 12 lbs. of steam, more or less.

We had hoped that the nominal horse was a dead one, and little to be expected at a meeting of electrical engineers. It is to be regretted that Mr. Crompton in his reply adheres to the statement that an economizer can cover a stoker's mistakes. The idea is as mischievous in practice as it is erroneous in conception. Never mind, we are told in effect, how cold you allow the furnaces to become, so long as you have an economizer to take the heat up—to absorb heat never generated! When the stoker is firing badly, he is wasting no heat to the economizer—he is not producing any heat to waste. How, then, can the economizer pick up what has not been dropped? Bad firing is bad for every class of boiler, and equally so for the feed heater, and Mr. Crompton's ideas on this question are entirely opposed to all known physical facts, and it would be interesting to have him explain how he arrives at his conclusions.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING

ELEC WORLD, N.Y.

ELECTRO-PHYSICS.

A New Phenomenon.—In a paper by Mr. Lehmann in "Wied. Ann.," vol. 52, No. 7, a translation of which is given in the Lond. "Elec.," June 22, he describes the following phenomenon: if a 70 volt current is passed through an aqueous solution of Congo red, a sharply marked halo is formed around both electrodes, having a blue color at the anode and "somewhat paler (red?) than the rest of the solution" at the cathode, but divided from it by a dark boundary; the two halos extend rapidly and finally meet in the middle, at which moment a dark blue pigment is precipitated at that point on the side toward the anode, while toward the cathode the solution becomes colorless; at the same time the liquid shows great disturbance where the dark blue and the colorless strata meet, while the rest remains perfectly quiet; the experiment is more conveniently made by thickening the solution with gelatine, sugar or glycerine. He describes the nature of the phenomenon as follows: the dissociated molecules appearing at the electrodes are given charges of the same sign by contact with them, and approach each other along the lines of force until they encounter molecules with which they combine chemically. The examination of a large number of other solutions gives precisely corresponding results, sometimes with very interesting details, among them being gelatinous aqueous solutions of marine blue, saffrauin, chrysoidin, etc. Whether colorless solutions also show the phenomenon, it is difficult to say, since the migration of the halos is only indicated by the formation of color, not by the formation of stripes. If the solution contains fine dust particles, a jerky motion of these is often observed where the edge of such a halo passes a particle. By filling a liquid with numerous small particles, the migration of the halos may be observed by means of changes in their density of distribution with nearly the same ease, commercial liquid India ink being especially suited for this purpose, if thickened with sugar or glycerine.

Hertzian Waves.—In connection with the subject mentioned in the Digest, June 30, under "Causes of Short Circuits," the Compiler has received a communication from Prof. Elihu Thomson, in which he states that as early as 1877, while working with a Ruhmkorff induction coil, one terminal of which was grounded and the other attached to an insulated metallic body, he and Prof. Houston noticed that when sparks were passing between the terminals of the coil, it was possible to obtain minute sparks from all the metallic bodies in the immediate neighborhood in the same room, and that delicate sparks could be obtained between small pieces of metal held in the hand near metallic bodies in any part of the building, even though the pieces were not grounded; these, he said, could only have been Hertzian effects. In connection with Prof. Lodge's coherer (see Digest July 7), Prof. Thomson relates the case of an electro-plater who found that he could not conduct his silver plating operations during thunder storms; it was found that he had considerable excess of battery power, and that his connections included a number of bad contacts of high resistance; under these circumstances a flash of lightning would cause coherence at the bad contacts, thus increasing the conductivity so as to cause an excess of flow of current. He suggests the use of Dr. Lodge's instrument in the study of waves propagated during thunder storms, about which practically very little knowledge exists.

Work of Hertz.—Prof. Lodge's lecture is concluded in the Lond. "Elec.," June 22; he gives some interesting experiments with his coherer (see Digest last week) and describes some optical and other experiments.

Electrostatic Rotation in Rarified Gases.—A translation of a paper by Mr. Arno is published in the Lond. "Elec." and "Elec. Rev.," June 22; he uses a small millwheel made of four very delicate brass vanes, mounted in a glass bulb containing very highly rarified air; by using a completely metallic mill-wheel, he was sure of eliminating all direct action of the rotating field upon the vanes of the wheel and of ascertaining the new effects due to the presence of the rarified gases; this apparatus is introduced between two pairs of copper strips arranged like a cylinder around this bulb cut longitudinally into four pieces; the brass vanes then commence to rotate in the same direction as the field itself; with an alternating current of a frequency of 40, a distance of 15 cm. between the strips, and a difference of potential of 7,500 volts, the intensity of the field was 1.67 C. G. S. electrostatic units, and the metallic wheel acquired a velocity of 50 turns per minute. Experiments showed that in the open air no such rotation will take place even in very intense fields, and that the cause of the phenomenon must therefore be looked for in the forces developed inside of the bulb, which are indirectly excited by a special action exercised by the rotating field upon the rarefied gases.

MAGNETISM.

Magnetization of Iron.—A Royal Society paper by Messrs. Hopkinson & Wilson is abstracted very briefly in the Lond. "Elec. Rev.," June 2; the object was to investigate the effects of the electric currents induced in the iron in delaying the reversal of the magnetism in the centre of the core when the magnetizing current is reversed; the solid cylindrical magnet had a diameter of four inches and formed a closed magnetic circuit; exploring coils of fine wire were embedded in the iron, and the currents in the coils were observed when the main current was reversed, these currents in some cases lasted over half a minute, in cylinders of different diameters similar events occur, but at times proportional to the squares of the diameters of the cylinders; some conclusions are drawn regarding the effects of local currents in the cores of transformers and armatures, but they are not given in the abstract.

Simple Equation for Magnetic Resistance.—A paper by Mr. Joubin is mentioned briefly in the Lond. "Elec.," June 22; he transforms Van der Waal's well known formula for the density and pressure of gas into corresponding quantities in magnetic terminology and arrives at Froelich's formula; as there is an abrupt change in the curve for a fluid when the vapor tension becomes zero and a change of state occurs, so there is an abrupt change in the magnetic curve at saturation, and it is the intention of the author to investigate this point in order to obtain, if possible, a simple fundamental equation for the magnetic resistance.

Intense Magnetic Field.—The magnet for producing the most intense field that has been generated, mentioned in the Digest June 30, is illustrated in "L'Ind. Elec.," June 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Finding Faults in Coils.—The following method is described by Mr. Campbell in the Lond. "Elec.," June 22; it applies more particularly when the fault between some unknown part of the coil and its bobbin has a variable resistance. A high resistance galvanometer is connected with the bobbin, and with first one and then the other of the free ends of the coil another coil is wound around the coil to be tested and is used as a primary through which a battery current is made to pass, the faulty coil acting as the secondary; the throw of the galvanometer is observed first for one terminal and then for the other, the number of turns up to the fault is then proportional to these two deflections, from which the fault is then localized. If the resistance of the fault is variable the galvanometer resistance ought to be high as compared with it; a ballistic galvanometer should be used if possible; if not sensitive enough, an iron core should be inserted and should preferably be laminated; this will also make the method more accurate; the primary coil may then be wound around the iron core instead of around the coil, the iron circuit being completed; an alternating current may also be used. A rough test may be made by placing a compass needle at the centre of the coil and noting the deflections when a battery is connected, first between the bobbin and one end of the coil and then between the bobbin and the other end.

Grassot Meter.—An illustrated description is given in "L'Ind. Elec.," June 10, a translation of which, together with the illustrations, is given in the Lond. "Elec. Eng.," June 15. It is extremely simple but appears to be intended only for small powers. A vertical silver wire, accurately calibrated in diameter, has its lower end resting on a glass plate, the end being immersed in a solution of nitrate of silver; a plate in the solution forms the other electrode; as the current passes, the end of the wire is consumed and a weight attached to the wire forces it down as fast as con-

sumed; a simple registering device operated by the descending wire indicates the current consumed in ampere-hours. The working potential is obtained by inserting a resistance in the lighting circuit which, for a meter of a maximum of three amperes, is equal to 0.4 ohm; a high resistance, in this case 2,750 ohms, is placed in series with the silver wire, and as this forms the greater part of the resistance, the ratio of the currents may be taken as equal to that of these resistances; the error in this meter is 6 per cent. for 0.5 amperes, 2 per cent. for 1.5 amperes and 0 for 3 amperes; these meters can be used in installations of from 1 to 6 lamps and their cost is quite small.

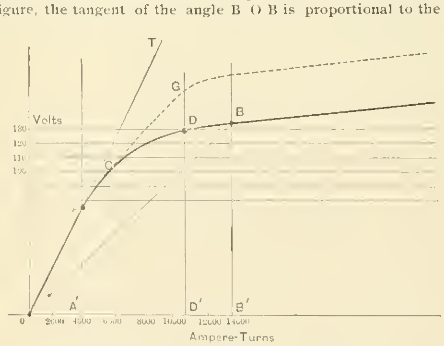
Bolometer.—The Edelmann bolometer is described and illustrated in the Lond. "Elec. Rev.," June 22; four thin blackened iron wires are stretched between suitable contact blocks, forming the four arms of a Wheatstone bridge, a resistance being inserted to bring about the balance; a difference of temperature of 0.0001° C. between two of the wires will give a deflection of 20 mm. at one meter, with a current of 0.25 ampere in the main circuit.

Lippmann Electrometer.—Mr. Bouty, in a paper read before the French Academy of Sciences, abstracted in "L'Ind. Elec." June 10, stated that the initial capacity of mercury is 140 microfarads per square centimetre after it has been in contact for some time with acidulated water, and that it decreases from that value to 28.

Spark Photographing.—An instrument for photographing falling bodies, or the splash of a drop, for instance, is briefly described and illustrated in the Lond. "Elec. Rev.," June 22.

DYNAMOS AND MOTORS.

Dynamos for Charging Accumulators.—In an article by Mr. Rechniewski in "L'Elec.," June 16, a translation of which together with the illustrations is given in the Lond. "Elec. Eng.," June 22, he describes an interesting improvement in the construction of such machines. When a dynamo is to be used for charging accumulators during the day and for direct lighting at night, it should run properly at, say, 110 volts for small loads, direct lighting, 120 volts for full load, direct lighting, and 170 volts for charging accumulators; to comply with these conditions and have the machine run in a stable manner and without sparking, is difficult; if constructed for 170 volts it will be unstable if run at 110 volts, that is, for the slightest variation in the velocity or in the output, the voltage will vary considerably; if constructed for 110 volts it is almost impossible to run without sparking at a higher voltage; the result could be accomplished by changing the speed, but this is impracticable; it could be accomplished by separate excitation from the accumulators but it will be difficult in that case to run without sparking. Referring to the adjoining figure, the tangent of the angle B O B is proportional to the resist-



Dynamos for Charging Accumulators.

ance of the exciting circuit; this can be varied with a rheostat under the conditions that the angle is smaller than that of the tangent T O to the curve at the origin, for if larger, the machine will not be stable; for this reason the excitation cannot be reduced below the point A and preferably not below the point C; as heating would occur above an excitation of 11,000 ampere turns corresponding to 130 volts, this machine has a range of only 30 volts; if, however, from the point C the characteristic can be changed to the dotted line, a range of 50 volts can be obtained without too much heat; this is accomplished by using very small teeth on the armature, so small that they are not saturated at 100 volts, while the field and armature are then still far from saturation; the saturating of the teeth gives the first part of the characteristic, after which the teeth will act as an air space and the characteristic will again become nearly straight, but with a different inclination; the same principle can be applied to over-compounded dynamos.

Synchronous Alternating Current Motor.—A paper by Prof. Ferraris is abstracted in "L'Ind. Elec," June 10; it is theoretical in character and leads to a new possible combination resulting in a synchronous alternating motor with an alternating field, the possibilities of which have as yet not been pointed out by any one; the theory is promised in a subsequent article. In a simple alternating current motor with a constant field, imagine that the field in which the armature turns, instead of being constant is alternating, and has the same frequency as the current traversing the armature; it is easily shown that in this case the machine can act as a dynamo or as a synchronous motor, the armature revolving at an angular velocity equal to double the frequency; it is thus possible to construct a synchronous alternating motor with an alternating field; such a motor may be started by using temporarily a di-phase current until synchronous speed is obtained, by means similar to those suggested by Mr. Brown.

A translation from the Italian of an article by Mr. Arno is published in the Lond. "Elec. Rev.," June 22; he gives a very complete table of 13 columns of data, the results of 14 tests of a 15 h. p. single phase synchronous motor of the Brown type, for 150 volts, 800 revolutions, 40 periods and weighing 1200 lbs.; curves for some of the principal measurements are also given; the first test was when the motor was at rest, thus giving the starting torque, the second when it was running at full speed but unloaded, and the others when loaded up to full load; the results do not admit of being abstracted; when delivering 0.78 h. p. the efficiency was 0.49 and when it gave 15.47 h. p. the efficiency was 0.82; the highest efficiency, 0.88, was obtained when running at 9 to 14 effective h. p.; the force on the lever arm of the brake while at rest is about 1-7 that when it ran at its normal load.

See also abstract under "Diphase Transmission of Power."

ARC AND INCANDESCENT LIGHTS.

Gas vs. Electricity.—In an inaugural address by the president of a Gas Institute, published in the Lond. "Elec. Eng.," June 22, an argument is given in favor of using gas and it is claimed that light from gas can be produced from 3 to 3½ per cent. cheaper than the price for which the equivalent electric light can be sold so as to produce the same profit that is being derived from the manufacture of gas.

The same journal contains the first part of a paper by Mr. Chew, read before a gas institute, which is very elementary in character and argues in favor of gas for the city of Blackpool. See also abstract under "Electric Light from Gas Engines."

Incandescent Gas Burners.—A report from the German by Mr. Muerchall is referred to editorially in the Lond. "Elec.," June 22; his experience is based on 37 to 471 burners; he thinks the mantels are strong enough to withstand the natural shocks; 60 c. p. can be obtained from 3.5 cu. ft. of gas per hour; the chimneys, costing 6 cts., have to be renewed about every 600 hours, and the mantles, costing 6 cts., every 500 hours, during which time they lose 4 per cent. in candle-power.

TRANSMISSION OF POWER.

Diphase Transmission of Power.—A very full description, together with a large number of illustrations, of a plant at the Decizee collieries in France is given in "L'Ind. Elec.," June 10; a brief abstract is given in the Lond. "Elec." and Lond. "Elec. Eng.," June 22, but without illustrations. The generating station is over three miles from one of the extreme points and almost two miles from the other, and has a capacity of 200 kilowatts, the generators consisting of a sort of twin alternator; the current is transmitted almost entirely on overhead wires. The motors have the stationary parts like the dynamos of the same power, but with double the number of poles; for those of 30 h. p., the illustrations of which are given, the number of poles is 16, that is, 8 for each circuit connected in series; the induction in the cores is 4.5 kilogausses; the currents create a rotating field of a velocity of 630 revolutions per minute; the moving armature has a hollow cylinder as core, carrying tangential coils in grooves; for normal running the armature is short-circuited; for starting, the two currents are led out through sliding contacts to two resistances, consisting of metallic plates immersed in a solution of sulphate of copper. When not loaded the speed is only 1 per cent. below that of synchronism, for half the charge it is 2.5 per cent. and for full charge from 5 to 6 per cent.; the induced currents in the armature represent almost the entire work corresponding to this loss of velocity; the efficiency is 80 per cent. at half charge and 88 per cent. at full charge; the motors require attention only once in 6 or 8 hours.

ELECTRIC RAILWAYS.

Gas Power Traction.—The Lond. "Elec.," June 22, refers editorially to recent experiments in Croydon. The car contains three cylindrical gas holders with a sufficient supply for an 8-mile run; the car is 18 ft. long, and weighs, with machinery, 5½ tons; an Otto motor, constructed specially for tramway work with slow and quick speed, is used; the ignition is effected electrically, and a condenser is used; an 8 h. p. gas engine at the station compresses the gas taken from the city mains into the cylinders, this power being sufficient for 5 cars; the pressure in the cylinders is about 20 lbs. per sq. in. at starting, and the cost of the gas is said to be 2 cts. per mile, run with a fully loaded car. It is thought that the capital per horse-power is relatively greater than for electric traction, and that the starting effort is more disadvantageous for gas motors than for electric motors; also that the cooling of the cylinders must involve some difficulties.

Tramways in Germany.—An itemized estimate of costs of a small horse car line and an electric line in Germany is given in the Lond. "Elec.," June 22; the total cost of the former is about $37,000 for a length of about 8 miles, and the cost of operation 5.44 cts. per car mile; while for the latter the figures are about $56,000 and 3.44 cts.

Hamburg Tramway.—An illustrated description of this road, equipped by the Thomson-Houston Company, is published in the Lond. "Elec. Rev.," June 22.

Lyons.—The illustrated description of this trolley line is concluded in "L'Elec.," June 9 and 16; a number of details are illustrated.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Electric Light Gas Engines.—In an article by Mr. de Segundo, in the Lond. "Elec. Rev.," June 22, he shows the great economy in using gas engines for generating current for lighting, giving all the details in his estimates, and making due allowance for all losses; he finds that 33.3 cu. ft. of gas correspond to the production of one kilowatt-hour, which, however, is not likely to be realized continually in practice; on the basis of 2.5 watts per candle of an incandescent lamp, he shows that 1,000 cu. ft. consumed per hour in a gas engine corresponds to 10,000 candle-hours, while if burnt in a gas burner at the rate of 5 cu. ft. per hour, per 16 candles, it will yield only 3,200 candle-power-hours, thus showing a very considerably greater efficiency in the transformation of gas into light by means of gas engines. He quotes at some length from an article by Mr. Bourquien, published in "La Lum. Elec.," Jan. 13-20 (see Digest, Feb. 10, 17, and March 3) on the basis of 18 cu. ft. per brake h. p. per hour, in large engines, he obtains 13,200 candle-hours electrically and 3,200 when burned in burners, showing a ratio of 4.125, from which he concludes that it is not unreasonable to say that it is practically possible to get four times the illumination per cubic foot from a gas engine, and using it for electric lights; he shows that in a very large station the saving in fuel would be nearly 200 tons of coal per annum. A similar comparison is made between arc lamps and high candle-power gas burners; for the former he assumes one watt per effective candle, and for the latter 6.71 candles per cu. ft. per hour in the Wenham gas burner, in which case also a very marked economy is shown in favor of the arc lamps. In referring to the article by Mr. Bourquin, he mentions the equation from which the equivalent number of arc and Wenham lamps for equal total cost can be calculated; he works out some figures and shows that, for instance, if a building requires more light than from 24 Wenham lamps of 130 candle-power each, it is cheaper to put down a gas engine plant and run arc lamps, than to use gas lamps, a result which he thinks should be accepted with much reserve, as the limit of candle-power, he thinks, is too low.

The Lond. "Elec. Eng.," June 22, contains a translation of an article by Mr. Wizt, given somewhat more fully in "L'Ind. Elec.," June 10, on the price of energy supplied by gas engines; with gas at three cents per cu. m. the annual price of 150,000 lamp-hours, with 15 c. p. lamps, is 1.06 cents per hectowatt-hour, for 450,000 it is .836 cent and for 1,500,000 it is .704 cent; these figures are based on balance sheets, in which provision has been made for interest and redemption at 15 per cent., but without allowing any profit; the expenses, however, are reduced, because the leads are short, it being proposed to erect stations consisting of a dynamo and a gas engine in the immediate neighborhood of a small collection of houses; for a group of 1,000 lamps requiring 65 kilowatts, he gives the detailed estimate of the cost of installation and the cost of running for a total of 97,500 kilowatt-hours, the results being an initial cost of $13 per lamp and 7 cents as the cost per kilowatt-houror 0.5 cent per 16 c. p lamp-hour.

Refuse Destructors.—In an editorial in the Lond. "Elec. Rev.," June 22, a paper by Mr. Baker is referred to; from his experiments he concludes that one pound of "breeze" sifted from the Paddington refuse will evaporate 21½ lbs. of water; the average consumption was six tons of breeze and one ton of coal, costing $10.50, which did the work of three tons of coal costing $15.75; he places no reliance on refuse used alone, nor does he favor its use unsifted; in order to obtain a red heat temperature he introduces an additional furnace burning some high class fuel; of a total of 100 tons of refuse, 70 disappeared in the furnace, being probably mostly water.

In a communication to the Lond. "Elec. Eng.," June 22, by Mr. Silcock, it is concluded that however successful the system of storage of power may be, there is not even sufficient power in the refuse of a town for public lighting alone, without considering the question of private lighting: a few figures are given to prove this.

Central Stations in Germany.—"L'Ind. Elec.," June 10, publishes at some length, including large double page tables, the results given in the German articles referred to in the Digest, June 2, 16 and 23.

Brussels.—A description of this station, with a few illustrations, is begun in "L'Elec.," June 16.

Glasgow.—The discussion of Mr. Arnot's paper on this station is given in the Lond. "Elec. Eng.," June 22.

WIRES, WIRING AND CONDUITS.

Cable for Ships.—At the Royal Society Exhibition Mr. Wimshurst showed a swivel for avoiding the kinks in cables attached to lightships; it consists essentially of two coils which are capable of turning on a common axis, mechanically connected but electrically disconnected, by means of which the current is transmitted over the swivel joint by induction.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Duplex.—Another communication in the discussion which has been going on in the Lond. "Elec. Rev." is published in the issue of June 22.

Telegraph between India and Europe.—A short article on the reduced rate of such telegraph is published in the Lond. "Elec. Rev.," June 22.

Pacific Cable.—Several other letters are published in the Lond. "Elec. Rev.," June 15. The Lond. "Elec. Eng.," June 22, contains an editorial on this subject.

ELECTRO-CHEMISTRY.

Primary Battery for Lighting.—The Lond. "Elec. Rev.," June 22, mentions but does not describe a new battery which has been used with some success in England; it is called the "Fulgur" and is an improved form of Daniel's cell; the chief improvement in the cell is in the septum, which consist of a preparation of cork somewhat resembling a certain floor cloth; the installation consisted of 50 lamps of 10 c.p. A storage battery is used and is divided into six sets, which are charged four hours at a time, one after the other in succession, once in 24 hours, the connections being made by an automatic switch operated by a clock; proper circulation of the fluids and the supply of copper sulphate and water are provided for; no figures regarding costs are given.

MISCELLANEOUS.

Resuscitation after Electric Shocks.—Some weeks ago an article was abstracted in these colums stating that Dr. d'Arsonval claims that a man apparently killed by an electric shock should be treated like one who has been drowned: in an article by that author in the Lond. "Elec. Rev.," June 22, 'L'Ind. Elec.," June 10 and 'L'Elec.," June 9, "this is modified by the statement that he had shown in 1887 that electricity occasions death in two very different manners: by lesion or destruction of the tissues (disruptive and electrolytic effects of the charge) or by excitement of the nerve centres, producing the arrest of respiration and syncope, but without material injuries; in the former case death is final, while in the latter it is merely apparent, and it is then possible to resuscitate the victim by artificial respiration, as in drowning; he claims that the alternating currents used in the execution of criminals in New York State produce nearly always the second kind of death.

Electric Cooking.—In an editorial in the Lond. "Elec.," June 22, it is suggested that instead of using an expensive kettle or an inefficient hot plate, an ordinary kettle could be used with an apparatus called a boiling stick, which is simply placed in the water to be heated, like a red hot poker; a silver tube with double walls containing a resistance of about 14 ohms ought to boil a pint of water in five minutes.

Sonometer.—At the Royal Society Exhibition Mr. Hawksley showed an instrument for measuring the acuteness of hearing, based on a note produced in a telephone by means of a make and break current in a sort of transformer in which the primary may be moved relatively to the secondary, the distance between the coils at which the sound appears to cease being a measure of the acuteness of hearing.

New Book.

ELECTRICITY ONE HUNDRED YEARS AGO AND TO-DAY. With Copious Notes and Extracts. By Edwin J. Houston, Ph. D. (Princeton). New York: The W. J. Johnston Company, Ltd. 199 pages, illustrated. Price $1.00.

Professor Dolbear in a recent address referred to the prevalent saying "Electricity is in its infancy" in the following words: "Electricity is not in its infancy. Despite what has been done, there is nothing in the present use of electricity but what has been known for many years. Arc lights were known eighty years ago; the telegraph is sixty years old, the telephone thirty, and the incandescent lamp ditto. We are not at work with new things or on new principles. If you are running a motor with electricity, it is not a new discovery in electricity to apply the same power to the operation of a lathe or a street car." At the present time, when the belief is so widespread that electrical science has sprung up in a day, it is convenient to have at hand an historical resume to check the many statements made to this effect, and the work by Prof. Houston serves this purpose admirably, besides being a most agreeably written book for general reading.

In tracing the history of electrical science from practically its birth to the present day, the author states he has, wherever possible, consulted original sources of information, and he was fortunate in having at his disposal for this purpose the excellent library of the Franklin Institute, containing, as it does, perhaps the most complete collection of scientific publications of the last century to be found in this country.

As a result of these researches, several revisions as to the date of discovery of some important principles in electrical science are made necessary. For example, Prof. Houston finds that Sir Humphrey Davy was anticipated in the discovery of the electric arc by many others, and in fact did not claim to have been the first discoverer of the brilliant effects of the arc. Proper credit is given to Gilbert for his inductive methods and in an appendix several writers are quoted to show that Bacon has been honored above his merit in this respect.

While, as the author states, the compass of the book does not permit of any other than a general treatment of the subject, yet numerous references are given in foot notes, which also in many cases quote the words in which a discovery was first announced to the world, or give more specific information in regard to the subjects mentioned in the main portion of the book. This feature is one of interest and value, for often a clearer idea may be obtained from the words of a discoverer of a phenomenon or principle than is possible through other sources.

An examination shows that the work is not a mere catalogue of subjects and dates, nor is it couched in technical language that only appeals to a few. On the contrary, one of its most admirable features is the agreeable style in which the work is written, its philosophical discussion as to the cause and effect of various discoveries, and its personal references to great names in electrical science. Much information as to electrical phenomena may also be obtained from the book, as the author does not seem to be satisfied to merely give the history of a discovery, but also adds a concise and clear explanation of it.

NOTES.

The Buyers' Reference has appeared, in its issue for the second quarter of 1894, in a new form. The size has been sufficiently enlarged to include

a finted column running through the book, which contains an alphabetical classified list of manufacturers of all apparatus, machineries and supplies used by the electrical street railway and allied industries. The typographical excellence of the publication continues to be maintained.

Portable Electric Deck Planer.

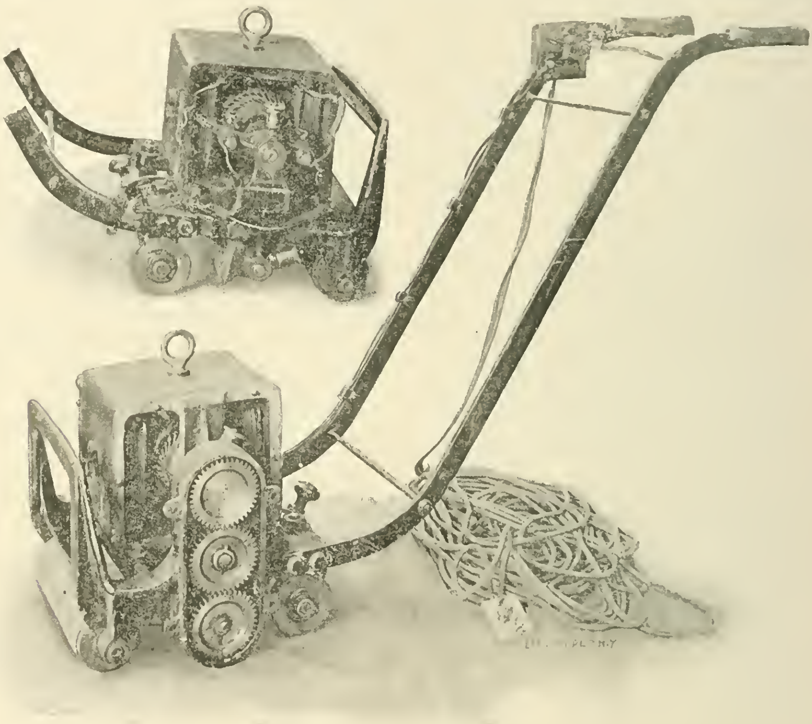
BY CHAS. J. DOUGHERTY.

The portable electric deck planer mentioned recently in an article on "Electricity at Cramp's Shipyard" and herewith illustrated, was imported from London by The Wm. Cramp & Sons Ship and Engine Building Co., of Philadelphia, to plane the decks of men-of-war and transatlantic steamers now in course of construction at their yard. Being a novelty, it has created quite a little curiosity among the workmen and visitors, and at present is in use planing the decks of the Government cruiser Minneapolis. It was manufactured by Mavor & Coulson, Glasgow, after Sayer's patent.

The motor rests upon a strong rectangular cast-iron frame, supported on the front end by a solid cylindrical roller 3¾ inches in diameter, and at the far end by the 4 inch wheels connected by a ¾-inch shaft. The motor is bolted down to this frame, and its weight with that of the roller is sufficient to give the machine a solid bearing surface upon the deck. The motor is series wound, of the iron-clad type; the fields and armature are incased in a ¼-inch solid casting, in the top or which is screwed a 2-inch eye bolt to facilitate the handling of the heavy machine from place to place. It is designed for twenty amperes at 100 volts and has a speed of 3,000 revolutions per minute. The commutator consists of twenty segments and the armature is of the drum type. Copper gauze brushes were used on the commutator at first, but owing to the rapid wearing of the copper, causing the circuit to open at the brushes and throwing the machine out of commission by necessitating the removal of the covering at the commutator end, solid carbon brushes were substituted, and have given perfect satisfaction.

The motion of the armature shaft is transmitted through a train of three gears, without any reduction, to the shaft, upon which are mounted the knives, and located immediately under the armature. There are two knives bolted to this shaft, set at 90 degrees apart. The cut of the knives is regulated by the rear wheels, which support the frame of the machine, and the shaft connecting these wheels is raised or lowered in the cast-iron frame by the action of an eccentric, whose throw is 3-16 of an inch, and operated by a small lever, as seen in the illustration, at the back of the motor. This lever moves in a slotted arc and is made stationary for any desired depth of cut by means of a thumb screw attached to the lever. The handles for propelling the machine are bolted directly to the frame. The ¼-inch rods hold the handles in position, and attached to the upper part of the right hand handle is placed the single pole knife switch mounted upon a small slate block. Brass couplings are also on this block for attaching the conducting wires, which consist of the lengths of flexible hemp cable about 100 feet long to allow sufficient run for the machine.

An ordinary rosette with fuse is attached to the cable, and the power is given to the motor by attaching the rosette to any of the temporary wires supplying current to the incandescent lamps throughout the ship. From the block two 8-stranded wires conduct the current to the motor, and are held in place by five brass clips secured into the frame handle and insulated from the same by hard fibre. A square brass box is fitted over the slate block at the handle and offers a protection from injury to the wires or switch. The motor is entirely incased when in use, although the illustrations do not show it, so that it is impossible for shavings or dust to touch the commutator or interfere with the machine. The wooden handles made to fit over the iron have been introduced to protect the operator's hand from soreness consequent from constantly pressing against the planer when working.



Electric Deck Planer.

Very little power is required to propel the machine over the deck; the operator by pressing the lever at the handle closes the switch, the motor starts, the knives in turn revolve, and pushing the planer along by hand the sharp steel knives plane down the rough deck to the smoothness of a ball room floor. The machine can do the work of fifty men in one day, and while it may seem on this account that it should be considered an enemy by the workingmen, on the contrary, its coming was heralded with delight, for the hardest and most tedious part of ship joiner work is the planing down of decks by hand.

Ignorance of American Practice.

In a recent preliminary report made for the city of Newcastle, England, the cable system was recommended as preferable to electricity, on the grounds that there was difficulty in "applying any electric system to towns where there are hills to surmount." The engineer, Mr. Laws, who made this statement, and who appears to be a mechanical, and not an electrical engineer, has evidently never seen nor heard of the electric lines in this country. We would suggest that he take advantage of the first opportunity to inspect the electric railways of the United States.

A New Switch.

BY P. E. MARCHAND.

It is sometimes desired to have three or four switches to control the same light or group of lights from different points. Having had to work out the case of three independent switches on a hall light some time ago, and seeing no multiple switches advertised except the three-way switch, which only covers two points, I made the following switch, which works in series with the ordinary three-way switches, and allows

FIG. 1.— NEW SWITCH.

of any number of switches to be used independently on the same light or group: *a* and *b* are ordinary three-way switches, *c* and *d* are the two wires running between them, and, as shown in the diagram, these two wires enter into every intermediate switch, so that there are four terminals in each of the latter; *e*, *e*, *e*, *e*, are four binding posts, to which wires are attached, as shown, and carrying at their base double

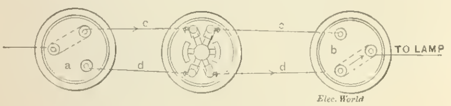


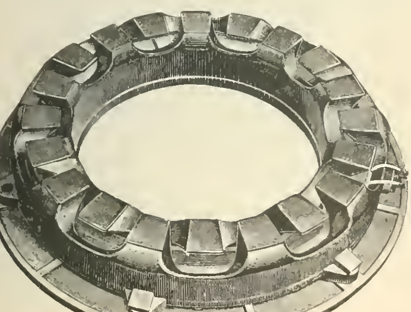
FIG. 2.— NEW SWITCH.

contact pieces, between which the arms, *f*, *f*, *i*, *i*, and *h*, *h*, slide alternately; *f*, *f*, and *i* are insulated from one another and from the hub, to which they are firmly secured; *g*, *g* is also firmly secured to the hub and carries at its ends well insulated sectors, *h*, *h*.

The action of the switch is through one-quarter of a turn, either way; as will be seen by the diagram, one motion transposes the line and the other straightens it, so that on whatever contact the three-way switches may be, a single motion of these intermediate switches will either turn the light on or off.

Electromagnetic Turbine Supporter.

Turbines used for driving dynamos are frequently constructed with a vertical shaft, the armature moving in a horizontal plane; in such aa arrangement the pressure due to the weight of the turbine shaft and the greater part of the dynamo must be taken upon some part of the rotating

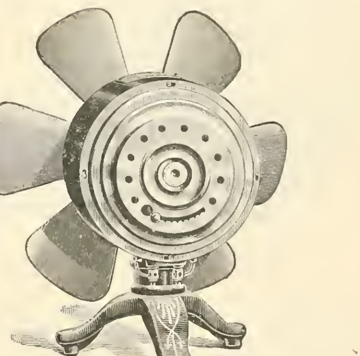


TURBINE SUPPORTER.

shaft; this is sometimes accomplished, as in the Niagara Falls plant, by supporting this weight on a water column pressing upward near the bottom of the turbine shaft, but with very great weights and small falls this arrangement is not always practicable. Furthermore, it depends on the height of the water column, is not capable of regulation, and as it involves the construction of the turbine it cannot be applied to existing installations. To overcome this, the Oerlikon Company, of Switzerland, has constructed a very simple apparatus, of which they have sent us a description. It consists essentially of an electro-magnet, as shown in the adjoining figure, made of one coil and a circle of alternate poles; this encircles the shaft and is firmly supported from the lower part of a suitable foundation; the shaft has fastened to it the armature in the form of a ring made of laminated iron consisting of a coil made of a band of iron; the attraction of this electromagnet for the armature is adjusted so as to relieve the bearings of the vertical pressure due to the weight. It can be constructed to support a weight of 110,000 lbs. The largest at present constructed is for about 30,000 lbs., and is in use at the installation of the Rhone Land and Water Power Company, Bellegarde, France. The power consumed is about one-third horse-power per ton pull, which is small as compared with the energy otherwise lost in an end bearing. It will readily be seen that such an apparatus is independent of the power, speed, water pressure, etc., and is readily adjustable by a resistance inserted in the circuit of the coil. The pull exerted by the magnet on the armature is about 42.6 lbs. per square inch. An apparatus for 12 to 14 tons requires about 20 amperes at 80 volts.

Fan Motors.

The fan we illustrate, manufactured by the Wagner Electric Mfg. Company, St. Louis, Mo., is designed for both direct and alternating currents, and embodies the result of the improvements which three years of manufacture and service have suggested. The motors have self-feeding carbon brushes, which will run a season without renewing, and self-oiling bearings, which hold an ample supply of oil for several months' run. All motors are adjustable in speed by means of a button



WAGNER FAN MOTOR.

conveniently placed They are finished in black enamel with gilt trimmings, and have a polished brass fan and end caps. These brass end caps entirely inclose the ends of the motor, protecting the armature, commutator and bearings from dust and dirt. They are fastened to the motor frame by a simple bayonet joint, requiring a slight twist only to disengage them entirely, without the aid of screw-driver or wrench. When removed they in no way interfere with the running of the motor, and the brushes and oil caps may be examined under normal running conditions. The weight and spread of legs make any fastening unnecessary, and rubber feet effectually prevent noise and vibration.

Iron Armored Insulating Conduits.

The notable tendency in architecture of late years has been toward the use of the most substantial materials obtainable, and in keeping with steel internal structure is the iron conduit system for wiring; by its means electric wiring, whether in the main conductors or in the smallest branches, has been brought to a most satisfactory state of efficiency. Herewith we illustrate some of the material used for this purpose, which

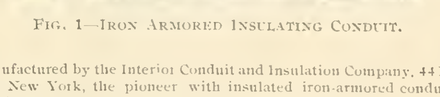


FIG. 1—IRON ARMORED INSULATING CONDUIT.

is manufactured by the Interior Conduit and Insulation Company, 44 Broad street, New York, the pioneer with insulated iron-armored conduit, as it was in the use of brass-armored conduit.

The tubing consists essentially of plain insulating Interior Conduit tubing placed within a heavy wall of lap-seamed, wrought iron pipe, which thus furnishes an armor ⅛ in. in thickness. The union between the

inner tube and its iron wall is firmly consolidated and welded together, and yet each is integral, the outer for protection from mechanical injury and the inner for electric insulation.

The flexibility of the system is maintained by the use of iron armored

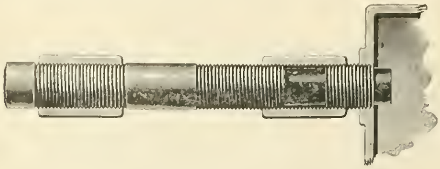
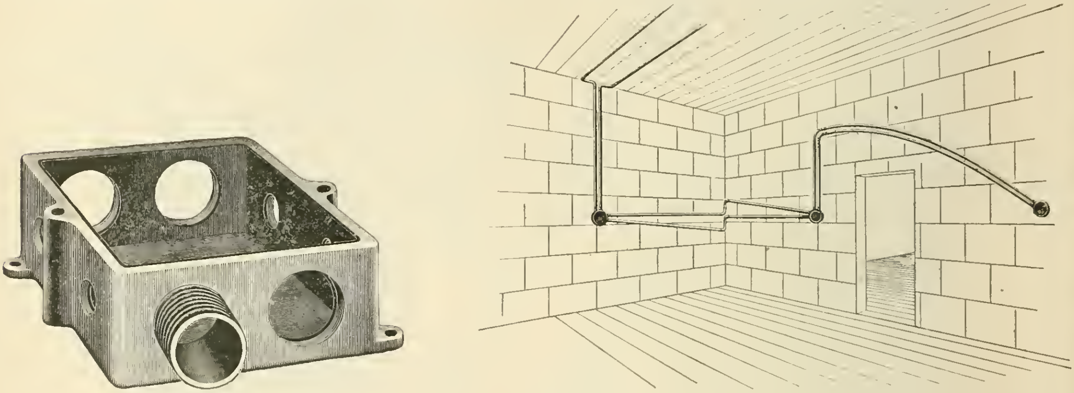


Fig. 2.—Iron Armored Insulating Conduit.

insulating junction boxes, elbows, couplings, etc. The conduit possesses the qualities of gas or water pipe, and by means of the tools furnished for cutting, threading, etc., can be installed with equal ease. It can be used under concrete, tiled or mosaic floors, etc., without the precautions



Figs. 3 and 4.—Iron Armored Insulating Conduit.

necessary with plain or brass-armored conduit; and at the same time a great saving in labor is due to the fact that it can be installed at an early stage in the construction of a new building, without anxiety as to the rough usage it may have to sustain.

Fig. 1 shows the actual size of 3-8 inch (inside diameter) iron conduit. Fig. 2 shows an ordinary and continuous insulating nipple, with the application of the latter to a junction box, illustrating how the continuity of the insulating system may be maintained if the tube should be too short by inaccuracy of measurement. Fig. 3 is a junction box; Fig. 4 illustrates the flexibility of the system and shows corner elbows and outlet boxes.

Electric Elevated Railroad in Chicago.

The West Side Elevated Railroad of Chicago is to be operated entirely by electricity. Influenced by the success of the Intramural electric railway at the World's Fair, which transported during the short time the Exposition was opened not less than 5,803,895 passengers, without a single accident and without any serious stoppage, and has proved an agitating leaven in the minds of the steam railroad men, only wedded to their steam power until a more economical system can be found, and after careful and thorough investigation of every possible system of passenger car propulsion, the president and directors of the West Side road decided that electricity was the most economical system. The generators and motors are already under construction in the Schenectady shops of the General Electric Company, where those for the Baltimore and Ohio Railroad Company are also nearing completion.

The company operating this road is the Metropolitan Elevated Railway of Chicago, the president of which is Mr. R. Summers Heyes, President of the St. Paul and Duluth Railroad, Chairman of the Reorganization Committee of the Atchison, Topeka & Santa Fe road and Director of the Metropolitan Traction Company, New York. The West Side Road, which connects that part of Chicago with the main city transit system, is to be a four track road for a greater part of the way, to allow of an express service. The line will cross the river on a four track way laid upon a drawbridge.

The power is to be generated by four dynamos. Two of these are to be of 2,000 h. p. each, and will be counterparts of the huge machine which ran in the Intramural power house during the Fair. This, at that time, was the largest ever built, but since these four have been installed in Brooklyn, N. Y., and three in Philadelphia, Pa. The two smaller dynamos are to be of 1,000 h. p.

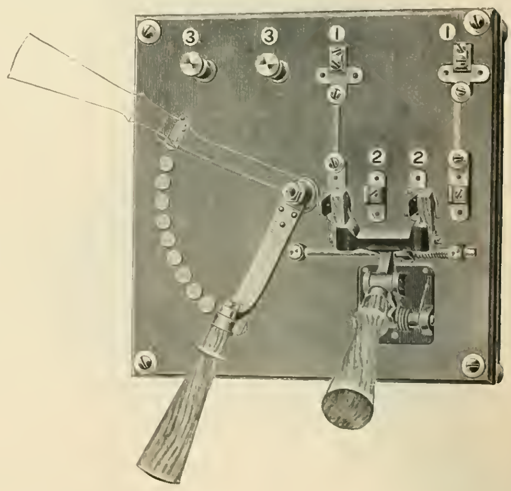
The current will be carried from the power house over the line by means of a "third rail" placed at the outside of each service track. A sliding shoe contact, hanging from the truck of each motor car, will take up the necessary current for the motor.

The first order covers fifty-five complete equipments, to comprise at first two powerful motors with the necessary controlling apparatus, and electrical air pump for the air brake, and the subsidiary apparatus and appliances. The motors will be to a great extent similar to those used at the Exposition. Two motors only to each motor car are to be used at present, but eventually two additional motors will be placed on each motor car. With the two motor cars four car trains will be run during the crowded hours of the morning and evening, and three car trains during the hours of slack travel, at a speed of thirteen miles an hour, including stops. With the four motor cars the trains will consist of six cars and the speed will be increased to fifteen miles an hour.

According to the present indications, the electric cars should be running on the elevated by the middle of November next.

Combined Switch and Rheostat.

In installing motors the switch and rheostat are generally placed side by side, and being entirely separate from each other, it oftentimes happens that through haste or carelessness the current is thrown on by the switch before the resistance is cut in by the rheostat, and as a consequence the motor armature is burned out or the fuses blown. The W. S. Hill Electric Co., of Boston, Mass., have placed on the market a self-locking starting switch, which we illustrate, in which the switch and



Combined Switch and Rheostat.

rheostat are combined, as shown, in such a manner that the former cannot be thrown in without first putting in all of the resistance, thus obviating accidents of this kind. An additional advantage is that the cost of the combination is less than that of a switch and rheostat separate.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 7, 1894.

THE ELECTRICAL STOCK MARKET'S course these days is governed by much the same causes that bring about the dullness at present characterizing all speculative markets. Just in the same way, though, electrical stocks, like the whole stock market, betray an inherent strength that has much of promise in it in the way of improving quotations. The whole situation is governed by the strike news, the uncertainty attending the fate of tariff legislation, the gold export question, etc., and until these disturbing influences are so far removed as to leave commerce uninterrupted, electrical stocks must continue to reflect the dearth of business by remaining inactive.

GENERAL ELECTRIC has displayed great strength within the last day or two. On Friday especially, there was good buying to the stock, purchases in many instances being directly traceable to insiders. There is an influential bull pool at work, but they have not been doing anything of late by reason of the inactivity in the stock market. But with the first signs of revival General Electric will be found to be a leader in the spurt toward higher quotations. It is well known that the business of the company has picked up a good deal of late. In addition to securing the contract for equipping the Metropolitan Elevated Railroad of Chicago, the company announced this week that it bas closed a contract with the West Side Electric Railway of Chicago, to equip its entire line with electricity on a principle similar to that employed last year on the Intramural Railway at the World's Fair. Tbe contract price is understood to be a little over $300,000, and was awarded to the General Electric Company after spirited bidding with the Westinghouse Electric & Manutacturing Company, of Pittsburg; the Siemens & Holske Electric Company, of Chicago; the Walker Manufacturing Company, of Cleveland, and the Electric Construction Company, of London, Eng. Boston advices are that these two large contracts are only samples of the company's enterprise. It is said to be now doing more than $10,000,000 gross manufacturing business per annum, and, if there is 20 per cent. profit in this—and there ought to be—the accumulation of a surplus for distribution among stockholders does not seem very far distant. The railroad business for May was the largest month's business in the history of the company, and June's total is likely to eclipse even May's big record. The sbops at Schenectady have already begun work on the Metropolitan Elevated contract, and the force will now be increased to take up the West Side job. There are hints in many quarters that much of the new business is taken at a loss, but most of the derogatory rumors concerning General Electric now afloat are directly traceable to disgruntled bear sources.

THE STREET RAILWAY AND ILLUMINATING PROEPRTIES' trustees knew what they were about when they bought last year some $12,000,000 General Electric treasury assets for one-third their face value. They managed to have enough money on hand this week from interest and dividend payments on their holdings to buy in 456 additional shares of the preferred stock, paying $98.48 per share. This makes a total of 11,943 preferred shares cancelled to date, while another $60,000 have been set aside to buy in more on July 11. The assets of the trust are certainly good,and had the General Electric been allowed to retain them there would be no occasion for the necessity of capital reduction or the talk of reorganization.

WESTINGHOUSE ELECTRIC issues have been unusually quiet since the determination of the Board of Directors not to make any distribution of profits among common stock holders at this juncture. Quotations have fluctuated only fractionally, and hardly any interest has been manifested either in the preferred or common shares. Official statements as to business conditions continue encouraging, as entire satisfaction with the situation and prospects is expressed. The new works at Brinton, near Pittsburg, are being hurried to completion, and the installation in the fall of the new factory plant means an era of increased prosperity.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY'S stockholders, in pursuance of a call signed by Directors John E. Hudson, James D. Davis, Edward J. Hall, W. D. Sargent and John Jameson, held a special meeting in this city yesterday "for the purpose of voting upon a proposition to increase the capital stock of said company to $12,000,000, consisting of 120,000 shares of the par value of $100 each." The officers of the company declined to divulge the business accomplished at the meeting.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric Co.	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
* Edison Electric Ill., New York	100	100	100½
* " " " Brooklyn	100	101	102
" " " Boston	100	116	115
" " " Chicago	100	135	145
* " " " Philadelphia	100	128	130
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com	15	15	17½
" " " " " pref.	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	36¼	36½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westingbouse Consolidated, com.	50	35	36
" " pref.	50	50½	51½
BONDS.			
Edison Electric Ill., New York	1,000	106½	107
Edisou Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	195	196
American District Telegraph	100	—	45
American Telegraph & Cable	100	88	89
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	—
Gold & Stock Telegraph	100	102	104
* Mexican Telegrapb	100	190	200
* Western Union Telegraph	100	83⅛	83⅝

* Ex. div.

THE INTERIOR CONDUIT AND INSULATION COMPANY'S Board of Directors, in declaring the 5 per cent. scrip dividend, touched on in these colums last week, pointed out that the net earnings that have accumulated for tbe past three years are now, after charging off to profit and loss account some $38,000 arising from expenditures for experimental purposes, hitherto carried as an asset, in excess of $100,000, represented by bills receivable, material and manufactured goods on hand. Pending the conversion of the scrip into fully paid capital stock, when an increase of capital stock has been provided for, the scrip possesses, so far as legal, all the qualities of stock and is entitled to all such dividends and privileges as may hereafter be declared upon the outstanding capital stock. It is further provided that the scrip shall be converted into stock before the declaration of the first cash dividend. The dividend was made payable in scrip instead of cash because the directors deemed it "sound policy to keep the company in strong financial condition by retaining its earnings in the form of quick available assets, instead of distributing any part in cash at tbis time."

BELL TELEPHONE is to have its $50,000,000 capital after all, Governor Greenhalge having signed a new bill permitting the company to sell $30,000,000 new stock at auction. Naturally stockholders who anticipated getting the new stock at par are somewhat disgruntled, and are expressing their disappointment by selling stock bought some weeks ago. There is a strong movement in favor of bringing the company to this State, where there is no statute preventing the issue of new capital at par, when the market price is bigher, and the agitation in favor of removal may lead to something definite. It is charged that the lobbying and other expenses attending the recent legislation cost the Bell Telephone Company over $250,000.

NEW INCORPORATIONS.

THE HERCULES ELECTRIC POWER COMPANY, Salt Lake City, Utah, has been incorporated.

THE CEBOLLA RAILWAY COMPANY, Deuver, Col., capital stock $100,000, has been incorporated.

THE FANNER ELECTRIC COMPANY, St. Louis, Mo., capital stock $60,000, has been incorporated.

THE UNION TELEPHONE COMPANY, Plum City, Wis., capital stock $250, has been incorporated.

THE JOHNSON ELECTRIC SERVICE COMPANY, Milwaukee, Wis., capital stock $150,000, has been incorporated.

THE HUMPHREY MANUFACTURING & PLATING COMPANY, Kalamazoo, Mich , capital stock $15,000, has been incorporated.

THE AMBLER ELECTRIC RAILWAY COMPANY, Reading, Pa., capital stock $12,000, has been incorporated by W. B. Krick and others.

THE EMMONS ELECTRIC COMPANY, Chicago, Ill., capital stock $15,000, has been incorporated by Charles P. Emmons and others.

THE OTTAWA MUTUAL TELEPHONE COMPANY, Ottawa, Ill., capital stock $15,000, has been incorporated by C. H. Hamilton and W. F. Heath.

THE GAS, HEAT AND POWER COMPANY, Mechanicsburg, Pa., capital stock $50,000, has been incorporated by Amos Z. Meyers and others.

THE WESTERVILLE & WORTHINGTON STREET RAILWAY COMPANY, Columbus, O., has been incorporated with a capital stock of $35,000.

THE COUNCIL BLUFFS & LAKE MANAWA ELECTRIC RAILWAY COMPANY, Council Bluffs, Ia., capital stock $40,000, has been incorporated.

THE NORTHWESTERN MILLING & POWER COMPANY, Spokane, Wash., capital stock $750,000, has been incorporated for operating mills, electric lines, etc.

THE MOMENCE ELECTRIC BELL STORAGE COMPANY, Momence, Ill., capital stock $15,000, has been incorporated by C. H. Lettigh, Lincoln Walker and Frank E. Lane.

THE ELECTRIC BOILER COMPANY, Rochester, N. Y., capital stock $50,000, has been incorporated by J. Henry Howe and others, to manufacture boilers and steam heating apparatus.

THE FREDERICKTOWN ELECTRICAL AND MANUFACTURING COMPANY, Fredericktown, Md., capital stock, $6,000, has been incorporated and will erect an electric light and power plant.

THE DARRIETT ELECTRIC MOTOR & DYNAMO COMPANY, New York, capital stock $20,000, has been incorporated by J. R. Anderson, of Montclair, N. J., and others, to manufacture electric dynamos and motors.

THE CHICAGO CROSS ARM COMPANY, Chicago, Ill., capital stock $6,000, has been formed to manufacture, buy and sell cross arms and electrical machinery and specialties. The promoters are H. M. Angle, E. H. Willard and C. S. Marshall.

THE ZUCKER, LEVETT & LOEB COMPANY, New York, capital stock $100,000, has been incorporated by Alexander Levett, Charles Loeb, W. R. W. Hentz and Henry L. Haas, to manufacture electrical apparatus, platers' supplies and polishing material

THE CO-OPERATIVE HEAT, LIGHT AND POWER COMPANY, Sioux Falls, S. D., capital stock $50,000, has been tormed to manufacture and sell electricity, etc. J. H. Drake, Chicago, Ill.; W. C. Bolton, New York, and Jno. Sunback, Sioux Falls, S. D., are the interested parties.

THE OSBORNE SWITCH COMPANY, Newark, N. J., capital stock $100,000, has been formed to manufacture and sell machinery and appliances, etc. The promoters are L. A. Osborne, D. Demarest, H. C. Hines, J. P. Beatty, F. E. Osborne, R. D. Beatty and Wm. C. Morton, all of Newark.

THE KANSAS CITY ELECTRIC RAILWAY COMPANY, Kansas City, Kan , capital stock $1,000 000, has been incorporated by E. L. Euggrow, Ozone Park, N. Y.; F. B. Wilcox, Kansas City, Mo., Louis Hummer, West Chester, Pa., and J. H. Parrott, R. A. Kope and P. F. Spickler, Kansas City, Kan.

THE UNITED ELECTRIC CORPORATION, Minneapolis, Minn., capital stock $10,000, has been formed to manufacture, buy and sell electrical apparatus for light, heat and power purposes and to construct and operate electric railways and power plants. The promoters are Samuel Grant, Faribault; George R. Kibbe, Paul W. Bossart and John H. Finney, St. Paul, Minn.

THE ELLICOTT ELECTRIC HEATING COMPANY, Buffalo, N. Y., capital stock $25,000, has been formed to manufacture apparatus for utilizing electricity for heating and power purposes. The directors are C. W. Pardee, John M. Schatcard, Daniel O'Day, Edwin T. Evans, G. Barrett Rich, George Urban, Jr.,

Jos. L. Hunsicker, Charles R. Huntley, John J. Albright, Edmund Hayes and Franklin D. Locke, Buffalo, N. Y.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 9, 1894.

KILLED BY ELECTRICITY.—Lawrence Arnold, a porter in a store at 777 Broadway, was killed on July 3 while oiling an electric fan, installed on an arc light circuit.

THE NASSAU ELECTRIC RAILROAD COMPANY, of Brooklyn, will erect a one-story brick power house on the wharf between Thirty-ninth and Fortieth streets, 106 by 150, with a corrugated iron roof.

MR. JOHN D. CRIMMINS is authority for the statement that a new trolley line will be built and be in operation on Jerome avenue in the next twelve months. The road will begin at MacComb's Dam Bridge, and run to Woodlawn.

THE WADDELL-ENTZ COMPANY, Bridgeport, Conn., has, through its receiver, applied to the court for permission to lease its works to E. P. Bullard, and a hearing on the application will be had at the Superior Court room, Bridgeport, on July 13.

MESSRS. HENRY HOLGATE and George W. Hunt, of The Royal Electric Company, Montreal, Quebec, were callers at the offices of The Electrical World on Tuesday, July 3. They expressed themselves as being highly pleased with the many interesting features of New York and Brooklyn.

MR. F. A. MASON, formerly secretary and treasurer of the Interior Conduit & Insulation Co., like all who stray from the flock, is now desirous of returning to his first love, "electricity." Mr. Mason's experience will make him valuable to any electrical concern with which he may become identified.

MR. JAMES E. M'ELROY, head of the firm of James E. McElroy & Co., of Chicago, formerly of New York, died suddenly on Saturday, July 7. He will be succeeded by his brother, Mr. Robert L. McElroy, the resident partner in Chicago. There will be no other changes in the management of the corporation.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 7, 1894.

THE BROWN ELECTRIC COMPANY, Boston, Mass., has just issued an illustrated catalogue covering its various electric light and railway supplies and general electrical specialties. The catalogue has evidently been carefully compiled, is neatly printed, and will be found to contain in "nutshell" form valuable information for the electrical trade.

THE HOLTZER-CABOT ELECTRIC COMPANY has issued a new edition of its descriptive catalogue of electrical house goods and supplies, which is in keeping with the current advance in catalogue work, the paper and press work being excellent and the cover tasteful in design and tint. A number of cuts are printed in colors on special paper, including views of a 300-number return call Keno annunciator, and a switchboard designed and built for the new Ames Building, Boston. The numerous cuts, as a rule, are excellent, as well as the descriptions and arrangement of matter.

AMONG THE RECENT REMOVALS of electrical firms in Boston, by no means the least important is that of Ziegler Bros., who now occupy the upper part of the Channing Building, in which is also located the establishment of The Pettingell-Andrews Company, the entrance to the office and factory being at 141 Franklin street, where they have a home of which they may justly feel proud. The office is spacious, with abundance of light, and affords splendid opportunities for the display of its various manufactures, and the manufacturing department is a model in every respect, embracing about 34,000 square feet, with abundance of light also, and plenty of room for the locating of its machinery. As is well known, the firm of Ziegler Bros. manufacture all kinds of electrical and mechanical apparatus. In its particular line of electrical specialties for schools, colleges and laboratories, the finest and most correct electrical and mechanical testing instruments, railroad signals, fire alarm and general protective apparatus, and, in fact, electrical and mechanical goods of all kinds, the firm enjoys deserved prominence. Its manufactures include from the smallest and most simple device to that of one and one-half tons weight, and it possesses all the facilities now for quick and satisfactory work. It is also kept very busy with repairing of all kinds, which is done promptly. Another important feature of the firm's business is the help it renders to inventors in the completion of new electrical ideas and models for patenting.

MR. FRED. A. SWAN, 180 Summer street, Boston, Mass., has recently completed the installation of an electric plant on Mr. W. H. Crane's yacht "The Senator," which for general design, neatness and workmanship certainly reflects great credit upon him. The plant installed consists of one 7½ h. p. vertical engine, connected directly to a 3½ kilowatt dynamo. This apparatus was constructed especially for Mr. Crane's yacht, and is very compact, the whole taking up only three feet in length. The switchboard is of polished black slate, mounted with nickel-plated knife switches and instruments, and is very compact and unique in design. There are 60 cups of storage battery capable of running forty 16 c. p. incandescent lights, which are to be used in case of accident or when it is not convenient to run the engine and dynamo. The cabin and pilot house are each fitted with four bull's eye nickel-plated fixtures, put in flush with the ceiling. All other parts of the boat are supplied with an abundance of light, there being a row of lights completely around the boat under the edge of the awning, and a three-light cluster in the centre of the awning over the entrance to the cabin. On the top of the pilot house there is mounted one 4,000 c. p. search light, capable of penetrating the darkness and bringing objects plainly to view at a distance of one mile. All of the electrical apparatus was designed by Mr. Swan; the dynamo was built by the Adams Electric Company, Worcester, Mass.; the engine by the Fore River Engine Company, Weymouth, Mass.; the switchboard by the Consolidated Electric Manufacturing Company, Boston; the storage battery by the Eastern Electric Light & Storage Battery Company, of Lowell, Mass.

PITTSBURGH NOTES.

PITTSBURGH, July 7, 1894.

THE PENNSYLVANIA GENERAL ELECTRIC COMPANY has entered suit against the Citizens' Passenger Railway Company, of McKeesport, to recover $13,356.22. The amount is claimed to be due for electrical appliances sold and delivered to the defendant company. A similar suit has also been entered by the same plaintiff against the McKeesport Light Company for $39,118.47 for amount due on electrical appliances.

STREET RAILWAY STATISTICS.—The following figures give a very fair idea as to the condition of the electric railroads in this city, being receipts and expenses for one year:

	Receipts.	Expenses.
Central Traction Company	$183,721	$171,677
Citizens' Traction Company	711,577	387,628
Duquesne Traction Company	357,714	256,004
Pleasant Valley Traction Company	397,123	312,326
Manchester Traction Company	482,347	274,687
Pittsburgh Traction Company	422,560	365,784
Birmingham Traction Company	332,049	171,874
Second Avenue Traction Company	111,379	71,686
West End Traction Company	121,576	72,726

The number of passengers carried by these companies were: Central, 3,926,521; Citizens', 14,594,850; Duquesne, 6,889,970; Pleasant Valley, 7,942,480; Manchester, 9 646,946; Pittsburgh, 8,364,852; Birmingham, 6,875,378; Second Avenue, 2,362,962; West End, 2,528,177.

CANADIAN NOTES.

OTTAWA, July 7.

MONTREAL.—The Electric Surface Company of Canada (Limited) has taken an action for $10,000 damages against the Merchants' Electric & General Service Company (Limited). This is an outcome of the recent difficulties between the two companies.

MONTREAL.—The city has entered an action against the Montreal Street Railway Company for $26,354. The city claims this amount under the by-law which provides for the company paying half the cost of clearing snow during the Winter. The company's lawyers interpret the by-law differently.

MONTREAL.—The Montreal Street Railway Company is making extensive alterations to its buildings on Cheneville and Vitre streets. It is the company's intention to transfer the motor and repair shops from Hochelaga to this place when the changes are completed, which will probably be in about two months.

MONTREAL.—A number of Canadian and American capitalists met recently, and discussed at some length the advisability of organizing a new line of street cars which would be propelled by gas instead of electricity, as at present. The necessary plans will be shortly drawn and submitted to a committee for approval.

BELLEVILLE, ONT.—The City Council has granted a franchise to S. E. Legier & Sons to build, equip and run an electric street railway in Belleville; also for the privilege of erecting poles for stringing wires for supplying light, power and heat. The promoters are well known business men of this city, and the work will be begun at once.

ST. GEORGE, N. B.—Notice of application for the issuing of letters patent to incorporate "the Saint George Electric Light Company (Limited)" is published this week. The object of the company is to light St. George and adjoining districts with electricity. The applicants are Albert T. Dunn, T. H. Estabrooks, Fred. B. Dunn, A. P. Banhill and Wm. Bayard, M. D., all of Saint John.

OTTAWA, ONT.—The annual meeting of the Ottawa Electric Railway Company was held last week. The report declared a dividend of 4 per cent. for the half year, and gave the following figures: During the year there have been 2,797,281 passengers carried, against 2,395,504 during the previous year. This gives 8,900 for every working day. The receipts are given as $129,484.02, the expenses being $83,324.64. The cars traveled 759,433 miles The company now operate 23 open cars, 31 closed, 3 postal, 2 closed and 2 open trailers, 5 sweepers and 53 electric equipments.

TORONTO. A report was read at the last meeting of the Fire and Light Committee, showing that the cost of operating a city electric plant would be $103 per year per lamp for 1,300 lamps. Ald. Hubbard favored adopting Mr. Keating's report, which estimates the cost of operating the plant at $81 78 per lamp per year, but he was defeated. In the secretary's report four engineers are said to be necessary, at a total for salaries of $6,500 per year; seven inspectors, twenty trimmers, several foremen, clerks, storekeepers, machinists and other employees are reckoned as necessary, and altogether a staff large enough to run a plant sufficient to light a city six times the size of Toronto is provided for in Mr. McGowan's liberal estimates.

OTTAWA, ONT.—The bill now before the Dominion Parliament bringing electric lighting under Government inspection provides that an electric company before commencing to supply light to a purchaser must declare to the purchaser the constant pressure at which they propose to supply the energy at his terminals. No variation greater than 3 per cent. from this pressure to be permitted. The bill authorizes electric companies to inspect purchasers' premises in case of a dangerous connection. They may also discontinue a supply of electricity until the defect has been remedied. For every default in complying with any of these provisions a penalty not exceeding $20 for every day during which the default continues is provided. Any person fraudulently using or diverting any electricity is to be deemed guilty of theft. Officers of electric companies are authorized to enter consumers' premises to inspect or remove apparatus belonging to the companies. If the consumer so desires, the quantity of electricity he uses shall be ascertained by means of a meter. Inspectors appointed to carry out the provisions of the act are to certify to the correctness of all meters before they are put in operation.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, June 27, 1894.

MULTIPLE-FILAMENT LAMPS.—Experiments with multiple-filament lamps having proved that there is practically no after-glow when the current is

switched off, the Admiralty have directed that they shall be adopted throughout the service for mast-head flashing lanterns.

MUNICIPAL STATIONS.—Two municipal electric light stations have been inaugurated during the past month. At one of these, viz., Portsmouth, Mr. Ferranti has introduced several novel features. His flywheel alternators are the first to be used in this country, and his alternate current rectifiers, which were used on the arc light circuits, have proved to be a great success. By means of these rectifiers Mr. Ferranti obtains a uni-directional constant current from an alternating constant potential, enabling the arcs to be run in series. The transformers at Portsmouth are of special design, being arranged so that by means of a key the windings may be altered for half or full load. The transformers are placed in pits below the foot pavements. At Burton, where the municipal station was inaugurated May 25, transformer pits are also used, and a man is sent round with a key to connect or disconnect them as the load rises or falls. This station is run in conjunction with the gas works, and uses the refuse coke breeze from the latter.

A MYSTERIOUS PHENOMENON.—The Portsmouth municipal electric lighting station was recently opened with the usual ceremony and feasting. After the feast the corporation and their guests proceeded to the central station, and were there subjected for some time to a somewhat trying after-dinner phenomenon. The station plant consists of two Ferranti flywheel alternators, and is illuminated by arcs, current for which is obtained from the alternators, but made pulsating and uni-directional by means of an appropriate commutator. The result was that the feasters witnessed the mysterious phenomenon of a steam engine driving ahead full speed, whilst the dynamo connected to it remained unconcernedly at rest. Worse, however, was to follow. The arcs were next run off another machine; the result was that the alternator, which had been previously remaining at rest, appeared to move first one way and then another, to rush suddenly round from left to right, pull up, and revolve slowly back from right to left. No ill consequences are reported.

AIR MOTORS FOR TELEGRAPH WORK.—At the last Royal Society Conversazione the Postmaster-General exhibited a Hughes telegraph and a Wheatstone transmitter, each of which was driven by a little Willmott air motor. The adoption of this means of driving these instruments results in an important gain. In the case of the Hughes apparatus, the air motor enables the 132 pounds weight, the winding gear, and practically all the train of wheel work to be dispensed with. In the case of the Wheatstone high speed transmitter the 42 pound weight, which requires rewinding every few seconds, together with its complicated train of wheel work, is also got rid of. The motor for the Hughes instrument consists of a fan with radial vanes, the air being admitted at one end of a diameter, and following the fan round the circle; this motor is practically self-regulating, since any interference with the motion causes the air pressure to be pulled up behind. The Hughes apparatus, although invented by an Englishman, has not till now been used in this country, although its use has been widely extended on the continent. When, however, the submarine cables between England and France were taken over by the joint Governments, our French neighbors insisted that the line to Paris should be worked by the Hughes apparatus. The result has been that Prof. Hughes' invention has been forced upon the notice of the Post Office officials, and some of our busiest lines are now, or shortly will be, provided with Hughes apparatus, it being found that they can be worked out under conditions which entirely stop the working of other instruments.

WOODHOUSE & RAWSON UNITED (LIMITED).—The public examination of the directors, managers and auditors of Woodhouse & Rawson United, which went into litigation some time ago, has recently been taking place, considerable interest being shown in the proceedings by the general public. So far as the matter has gone up to the present it would appear as if on the occasion of the numerous progeny of small Woodhouse & Rawson concerns being taken over by a single big concern, to which the public were invited to subscribe, transactions of a somewhat peculiar kind took place. As usual the new directors of the big concern (Woodhouse & Rawson United) made no inquiries until the public had been invited to, and had actually subscribed, though they then became so uneasy with regard to the whole matter that they promptly retired, leaving the new concern entirely in the hands of gentlemen interested in the old concerns. The good will of the old businesses was valued at £75,000 by the vender of them, and this valuation was accepted without demur by the purchasing company; one of the directors of the concern blandly admitting in court that if he had been purchasing property with his own money, and for himself, he should not tamely accept the vender's estimate of its value. The auditor appears to have certified the general correctness of various balance sheets, supplementing his certificates by reports which were of course suppressed. The law at present seems to be that an auditor is bound to address these sort of reports to the shareholders, but is not empowered to see that they get them. It is a great pity for the electrical industry that the firm of Woodhouse & Rawson should have obtained the reputation of being an electrical manufacturing firm, where their business was little more than that of company promoting.

News of the Week.

Electric Light and Power.

HASTINGS, NEB.—The electric light plant will be improved. H. W. Miller is manager.

NASHVILLE, TENN.—The Cumberland Light and Power Company is preparing to enlarge its plant.

OSHKOSH, WIS.—Address the city clerk concerning the municipal electric light plant to be established.

SPRINGFIELD, O.—The Hess Storage Battery Company will establish a plant to construct the Hess battery.

MT. CARROLL, ILL.—Address the town clerk for information concerning an electric light plant to be established.

FT. DODGE, IA.—The City Council has granted a franchise for 21 years to S. T. Meservy for a street railway and electric lighting plant.

HILLSBORO, TEX.—The Hillsboro Investment and Electric Company intends erecting an electric plant, and is in the market for the apparatus.

NORWALK, CONN.—The Norwalk and South Norwalk Electric Light Company is about to be placed in the hands of a receiver, who has been applied for.

BRUNSWICK, MO.—The Franklin Electric Company, of Kansas City, has been awarded a contract to erect an electric light and water works plant at a cost of $10,600.

PENSACOLA, FLA.—The Citizens' Electric Light and Power Company has given out a contract for the erection of buildings, and is now in the market for the necessary apparatus.

AUGUSTA, GA.—C. V. Walker, Dyer Building, will give information in regard to free sites for manufacturing purposes. Power will be supplied at $5.50 per horse power per year.

JAMESTOWN, N. Y.—O. E. Jones asked that the Board of Public Works be empowered to employ an architect to assist in preparing plans and estimates for the electric light building.

JACKSONVILLE, FLA.—Commissioner King has presented plans and specifications for an electric light plant on which to base advertisements for bids at the meeting of the Board of Public Works.

BEL AIR, MD.—The Record Manufacturing Company will construct an electric light plant to light the town. The plant will be installed two miles from the village, and will be operated by water power.

HOPKINS, IA.—Hopkins has decided to have electric lights, and the council has passed an ordinance giving to Peter Milroy the exclusive franchise to maintain an electric light plant there for a term of twenty years.

BINGHAMTON, N. Y.—The State Hospital trustees held a special meeting, at which time Capitol Commissioner Perry's plans for an extension of the present electric lighting system to the adjoining farms were adopted, and Secretary Rogers was instructed to advertise for proposals for the construction of the same.

BAY CITY, MICH.—It was erroneously stated in these columns in the issue of June 30, that the Common Council had decided to expend $12,000 on its municipal plant. We are informed by the superintendent of the plant that this is a mistake, as the Common Council has concluded not to expend any money on the plant this year.

NIAGARA FALLS, N. Y.—At the last meeting of the Common Council the petitions of the Niagara Falls Hydraulic Power and Manufacturing Company and the Niagara Falls Power Company for franchises to erect poles and string wires for the transmission of power and heating, lighting and manufacturing purposes by electricity were finally terminated by granting both of these companies the desired franchises under restrictions.

The Electric Railway.

HANOVER, MASS.—Hanover citizens are agitating the question of building a new electric railroad.

EAST MAUCH CHUNK, PA.—The citizens of East Mauch Chunk have decided on the extension of the electric railway.

CHESTER, PA.—The Crozier property, in South Chester, has been sold to a company that will erect an electrical engine works.

CHICOPEE, MASS.—The Chicopee Street Railway Company has petitioned for a franchise to construct a line from Holyoke to Springfield.

HUMMELSTOWN, PA.—The Citizens' Railway Company of Harrisburg has asked permission to build an electric railway through the borough.

JOPLIN, MO.—It is proposed to form a syndicate to buy the property of the Joplin Electric Railway and Motor Company and to extend the railway to Galena.

BALTIMORE, MD.—The Walbrook, Gwynn Oak and Powhattan Railroad Company has executed a mortgage for $100,000 to secure funds to build its electric road.

YOUNGSTOWN, O.—Sealed proposals will be received at the office of the Board of City Commissioners of Youngstown until July 14, for the construction and operation of a street railway line. Howard Edwards is city clerk.

BROCKTON, MASS.—A number of citizens, with Mr. J. C. Snow, the real estate man, as prime mover, have associated together as the West Side Street Railway Company to build and operate a new line of electric street railway in this city.

OMAHA, NEB.—L. W. Hardy, of Chicago, and T. J. Peachy, of Omaha, have invented an underground trolley system, consisting of a conductor in a trough, covered by a flexible rubber diaphragm, heads of rivets which are pressed against the conductor by a traveling device underneath the car, thus making contact for the motor current.

STROUDSBURG, N. Y.—The Delaware Valley Electric Railway Company, stock $1,000,000, all of which has been subscribed for by wealthy Philadelphia parties, will construct the electric road from Stroudsburg to Port Jervis. It is expected that a portion of the road between Port Jervis and Milford and Bushkill and Stroudsburg will be completed by October 1 of the present year, and between Milford and Bushkill on or before June 1, 1895.

WHITE PLAINS, N. Y.—The Board of Trustees has finally adopted the Electric Railroad Committee's report. The companies desiring the franchises to construct a railroad from Mamaroneck to White Plains and from Elmsford to White Plains must deposit $5,000, to be forfeited if the roads are not built within a year, and must give a $20,000 bond for fifteen years, as a guarantee to fulfil every requirement exacted by the village authorities. The vote granting franchises to the New York, Elmsford & White Plains & Mamaroneck Railway Company were reconsidered.

PORT JERVIS, N. Y.—The Delaware Valley Railway Company, of Pennsylvania, capital $1,000,000, has been chartered. The treasurer, Simon Friedberger, is also treasurer of the Wakefield Electrical Engineering Company, of Philadelphia; Mr. Ellicott Fisher is president, and Mr. Michael W. O'Boyle, secretary. Among other incorporators are G. H. Lang, Joseph S. Potsdamer and Louis Lang. This company will construct and operate forty miles of road, from Port Jervis, N. Y., to Stroudsburg. A large force of men will equip the work at both ends of the line at once, and at least twenty-five miles will be built before the end of the year.

POTTSVILLE, PA.—The Car Equipment Company of Philadelphia has purchased the controlling interest of the Schuylkill Electric Railway Company, of Pottsville, Pa., and intends to extend the line about twenty-five miles in and around Pottsville, connecting St. Clair, Middleport, Tremont, Schuylkill Haven and other towns near by. Jesse Newlin and Robert Alliston have retired from the old Board of Directors, and W. A. Barritt, Jr., and Charles H. Barritt, president and treasurer respectively of the Car Equipment Company of Philadelphia

have been elected to fill the vacancies. J. B. Stuart, of Philadelphia, has been appointed electrician and general superintendent, and his success in the construction of the Pottstown, Camden and Gloucester roads will assure an efficient system for the roads at Pottsville. The Schuylkill Electric Railway Company has a capital stock of $150,000, which was raised by popular subscription from the residents of Pottsville and fully paid in. The road was originally built out of the capital stock, and the improvements or betterments from time to time were contracted for out of an issue of bonds. The road has a bond indebtedness of $95,000. The Schuylkill Electric Railway proper consists of ten miles of road with eighteen car equipments, about half of which are new and the remainder consisting of Short apparatus, which will be no doubt replaced in the very near future with a more modern equipment. New feeder wire will be put in on the entire system to supply sufficient and additional power for the extra car equipment that will be added, and a new car barn will be built at Palo Alto. The entire system will be overhauled and will be put in a first-class position as soon as possible.

Personal Notes.

TWO NAMES well known in electrical circles, not only in Boston, but throughout New England and the whole country as well, are those of A. Arthur Ziegler and J. Oscar Ziegler, members of the firm of Ziegler Bros., of Boston, Mass., manufacturers and dealers in electrical specialties for schools, colleges and laboratories. Mr. A. Arthur Ziegler is now about 31 years of age, was born in Switzerland, and was about 7 years of age when his parents came to this country. He was given a good public school education, and at the early age of 16, in the year 1879, he commenced his electrical apprenticeship with the old establishment of Charles Williams, Jr., of Boston, where his brother, J. Oscar Ziegler, was foreman of the instrument and experimental department. This was in the early days of electric work, when the telegraph was supreme and the telephone just entering. He remained with Charles Williams and the Western Electric Company, which succeeded him, until just previous to the removal of the plant to New York, in all about six years, during which time, through close application and well-directed energy, he acquired a thorough knowledge of the business. Desiring to familiarize himself with large machinery, he afterwards identified himself with the South Boston Iron Works. From thence he became associated with the Schaeffer Electric Manufacturing Company, afterwards known as the Germania Electric Company, leaving this company to connect himself with A. L. Russell, of Boston, who succeeded to a portion of the business of Charles Williams, with whom he remained for a number of years. He was also identified for a short period with the Holtzer-Cabot Electric Company. On May 1, 1889, he organized the present firm of Ziegler Bros., composed of himself and his brother, J. Oscar. Mr. J. Oscar Ziegler was also born in Switzerland, and is now about 43 years of age. He was given an excellent school and college education in Switzerland, and at the age of 17 was apprenticed to A. Saurer & Sons, in the city of Arbon, on Lake Constance, who are large manufacturers of steam engines and silk embroidery machinery. He was about 20 years of age when his parents located in this country, and began his career here with the American Safe Company, confining himself particularly to the intricate mechanism of "time locks." In 1873 he associated himself with Charles Williams, Jr., of Boston, and was closely identified through this connection with Prof. Bell in all his early experimental work upon the telephone. He was also in these early years brought into intimate contact with Moses G. Farmer. Previous to the organization of the firm of Ziegler Bros., like his brother, he was associated with A. L. Russell and the Holtzer-Cabot Electric Company.

Miscellaneous Notes.

JUDGE RICH'S DECISION in the case of the Buckeye Company, of Cleveland O., was sustained by Judge Dallas in an opinion handed down from the bench of the United States Circuit Court at Lancaster, Pa.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., lost its extensive electric manufacturing plant by fire on June 30. During a storm the buildings were twice struck by lightning, the second stroke shattering the machine shop and starting the fire. The damage is estimated at $50,000, on which there is $35,000 insurance. About 125 workmen are thrown out of employment, but temporary quarters will be occupied at once, as the company has many orders ahead. President Davis and his associates have our sympathy, but their well-known business enterprise will doubtless meet with a stimulus from this misfortune, which will more than counterbalance it.

Trade and Industrial Notes.

WILMINGTON, DEL.—Worrell & Ryon, electrical engineers, have dissolved partnership.

J. JONES & SON, 67 Cortlandt street, New York, report that they have just closed a contract with one of the large motor companies to furnish them with a year's supply of their Anti-Thunderbolt paper. They will also in the near future keep in stock a complete supply of the Kester lamps, made by the F. B. Little Company, of Buffalo.

THE J.T. CARPENTER TAP & DIE COMPANY, Pawtucket, R. I., has issued a new catalogue and price list containing illustrations, descriptions of its taps, dies, tap wrenches and other goods manufactured by it.

THE HARRISON INTERNATIONAL TELEPHONE CONSTRUCTION COMPANY will move its general offices to the Chamber of Commerce Building, Chicago, this week, the general offices of The Harrison International Telephone Company remaining here. This change is made imperative from the great growth of the Western business of this flourishing company.

THE ST. LOUIS RAILWAY COMPANY, of St. Louis, Mo., have placed the order for their new car barn with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 64 feet in width, and 185 feet in length, with brick walls, the roof being of iron covered with The Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering. It is the intention of the railroad company to make this station absolutely fireproof and thereby save insurance.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that it started into the Summer season without any special arrangement on a direct current fan motor, intending to devote all of its energy to the sale of the Meston alternating current outfit. A heavy demand set in, however, for a direct current fan motor, and it has succeeded in getting hold of such a desirable article in the Acme direct current fan motor that it is pushing them extensively, and claims to have the best direct current fan motor introduced this season.

THE STANDARD ELECTRIC TIME COMPANY, on and after June 20, 1894, will have its main office and factory located at 23 Jefferson street, Waterbury, Conn., where all communications, express and freight, should be sent, instead of to New Haven, as heretofore. The company will here have greatly increased facilities for the manufacture of its electric time system, self-winding clocks, electric tower clocks, and electric dial system, all of which have established an enviable reputation for simplicity and reliability.

THE MASON TELEPHONE COMPANY is the name of a new concern which has just been organized in Richmond, Va., to manufacture telephones. Messrs. C. T. and W. A. Mason are the inventors of the telephone, and have perfected an exchange system that has been introduced with success in several cities. The advantages claimed for the new system are non-infringement, simplicity of construction and superiority of transmission of sound. A number of the most prominent men in Richmond are interested in the company.

THE WAKEFIELD ELECTRICAL ENGINEERING COMPANY, No. 731 Reading Terminal, Philadelphia, Pa., is very busy in railway work; it is just finishing a seven mile extension from Harleigh to Freeland, Pa., for the Lehigh Traction Company, and have started work on an eight-mile road from Tamaqua, through Lansford, to Summit Hill, Pa., and has also closed contracts for a 40-mile road from Port Jervis, N. Y., to Stroudsburg, Pa. Mr. Charles E. Hague, formerly with the Pennsylvania General Electric Company, is general manager of the Wakefield Electric Engineering Company.

QUEEN & CO., INCORPORATED, of Philadelphia, have a new form of central station voltmeter, the dial of which is arranged in the shape of a semicircle 14 inches across, the scale covering 180 degrees. Thus it will be evident that the divisions are far apart so that small fractions of a volt can be easily read at some distance. An adjustable index, which can be set at any desired point, is also supplied. This voltmeter can be left in circuit all day long without injury, and is described in circular No. 535, which the makers will mail upon request. They also have a full line of switch-board instruments for isolated plants.

THE E. G. BERNARD CO., 43 Fourth street, Troy, N. Y., have bought out the stock of material, completed and partly completed machines and special tools of the Adams Electrical Company, of Worcester, and will continue the manufacture of the Adams dynamos and motors, making a specialty of sizes up to 10 k.w. capacity, both high and low speed. The above stock of completed and partly completed machines will enable the E. G. Bernard Co. to continue the business at once. Mr. A. D. Adams, late manager of Adams Electrical Company, will be connected with the E. G. Bernard Co. in the manufacture and sale of the machines.

BARTLETT & CO., engravers and printers, 21 Rose street, have issued a beautiful pamphlet entitled "A Modern Triumvirate," which describes in an agreeable style the different departments of their business. The exceeding fine character of the work done by this firm is well illustrated in this brochure, not only in engraving but in press work and binding. The embossed cover and title page are works of art in every sense, and the whole production is one that could scarcely be equalled outside of France, though even there we know of no firm that can rival Bartlett & Co. in commercial catalogue work. Though the Germans have recently issued some very elaborate commercial catalogues, they lack the artistic element so predominant in the work of this firm.

THE ELECTRIC STORAGE BATTERY COMPANY, Drexel Building, Philadelphia, has issued a new edition of its catalogue of the chloride accumulator, which contains considerable new matter, including some particulars of the Paris-St. Denis storage battery tramway, an account of which appeared in our columns several months ago. Five types of cells are now listed, ranging in capacity from 12½ to 5,000 ampere hours. Types C and D have been added, the plates of these being 4x4 inches and 6x6 inches respectively. An appendix contains a number of flattering testimonials to the merits of the chloride accumulator, among the writers of which are Professors Houston, Chandler, Callender and Barker, A. E. Kennelly, the North American Phonograph Company, the American Graphophone Company, the electrical engineer of the Edison Kinetoscope, and users of the battery for isolated and central station lighting purposes, and some others.

THE CHAS. E. GREGORY COMPANY, Chicago, Ill., report the following sales for June: Fifty light D 12 Thomson-Houston arc dynamo, to P. Norcross, Janesville, Wis.; two 30 and one 20 light Sperry arc dynamo, to B. Marks, Chicago; one 6-light Sperry arc dynamo, to Jas. I. Ayer, New York, N. Y.; one 3-light Excelsior arc, to J. P. Karr, Reynolds, Ind.; one 500-light 1,000-volt Thomson-Houston alternator, to P. Milroy, Hopkinton, Ia.; two 180 ampere Westinghouse generators, to International & Wells Packing Company; one 180 ampere Westinghouse generator, to W. T. Osborne & Co., Kansas City, Mo.; one 210-light Edison generator, to Geo. B. Weiss & Son, Chicago; one

25-h. p. direct-connected Westinghouse motor, to O. H. Parker, Anniston, Ala.; three 3-h. p. and one 5-h. p. Westinghouse motors, to Andrews & Johnson, Chicago; one 2-h. p. Sperry series generator, to John Raber, Chicago; one 3 kw., 500-volt Edison motor, to M. Schu, Aurora, Ill.; one 3 kw. 220-volt Edison motor, to Chicago Braid and Embroidery Company; one 1 h. p. Crocker-Wheeler motor, to Four Lakes L. & P. Company, Madison, Wis.; one 1 h. p. C. & C. motor, to A. L. Daniels, Marion, Ia.; one 1-h. p. Jenney motor, to E. J. Davis, Aurora, Ill.; one 1-h. p. Rockford motor, to George Wolfe, Chicago; one 1-h. p. Detroit motor, to Baltimore Cafe, Chicago; one 1-h. p. Crocker-Wheeler, to Lyon & Healy, Chicago; one 1-h. p. Edison motor, to Goltz & Sinclair, Milwaukee, Wis.; 14 Edison arc lamps, to W. T. Osborn & Co., Kansas City, Mo.; 6 Knowles D. C. arc lamps, to Kuh, Nathan & Fischer, Chicago; 15 Edison arc lamps, to Max Eichberg, Chicago; 6 Edison arc lamps, to B. F. Harris, Jr., Champaign, Ill.; and a total sale of 47 fan motors of various sizes and inds.

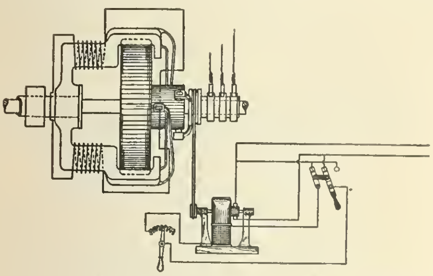
ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED JULY 3, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

522,189. ELECTRIC RAILWAY TRUCK; F. O. Blackwell, Lynn, Mass. Application filed May 1, 1891. The combination with the driving axle of a railway truck and motor shaft connected thereto through flexible coupling and gearing, of a gear wheel casing having a portion flexibly mounted to follow the movement of the motor shaft.

522,209. ORGAN; R. Hope-Jones, Birkenhead, England. Application filed September 18, 1891. The combination of a portable console frame, a key frame adjustable as a whole thereon, and a separable portable pedal frame.



NO. 522,241.—ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE.

522,231. AUXILIARY FIRE ALARM SIGNAL SYSTEM; J. Sachs, New York, N. Y. Application filed November 8, 1893. This comprises an alarm box, an auxiliary releasing circuit, a working generator, an automatic switch for throwing said generator into circuit, a tell tale signal, and a circuit breaker in the circuit, the generator being operated by the tell-tale mechanism.

522,232. ELECTRIC SAFETY FUSE; J. Sachs, New York, N. Y. Application filed April 10, 1893. This comprises a strip melted by an excess of current, in combination with a material surrounding the strip, such as silicic acid, that will combine with the metal and form a non-conductor.

522,233. ELECTRIC ARC LAMP; A. Schweitzer, Alleghany, Pa. Application filed December 28, 1893. The combination with oppositely extending arms for supporting the carbons, one of the arms having a hinged joint, of means for adjusting the hinged section laterally to align and bring the carbon points in coincidental relation.

522,241. ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE; Elihu Thomson, Swampscott, Mass. Application filed October 21, 1893. The method of varying the periodicity of an electric current, which consists in successively and continuously changing the points of line connection in either direction around a rotating commutator independently of its own rotation. (See illustration.)

522,242. PROCESS OF MANUFACTURING INSULATING MATERIAL; A. F. Tinnerholm and C. F. Paterson, Schenectady, N. Y. Application filed July 31, 1889. A sheet composed of scales or pieces of mica, and made up by adding less than 10 per cent. of powdered gum or resin between the scales.

522,274. DYNAMO ELECTRIC MACHINE; C. E. Scribner, Chicago, Ill. Application filed June 1, 1889. The two pole pieces of a dynamo, each provided with two cores, each pole being on opposite sides thereof, and the coils thereof being included in a shunt around the translating devices which are being supplied with current from the machine, in combination with a third core for each pole piece connected with a projecting portion of each pole piece, the extra pole pieces being on opposite sides of the armature and in the same plane, and with the other cores in a plane at right angles to the axis of the rotation of the armature, the extra pole pieces being provided with coils included in the main circuit.

522,275. REGULATOR FOR DYNAMO ELECTRIC MACHINES; C. E. Scribner, Chicago, Ill. Application filed October 14, 1889. This comprises a brush carrier constantly impelled in one direction by a constant force, and an intermittently acting motor adapted to impel it in the opposite direction, the frequency of the operation depending upon the strength of the main current.

522,276. ELECTRIC ARC LAMP; A. W. Smith, San Francisco, Cal. Application filed April 2, 1894. This comprises a sliding frame, a solenoid coil, a core, bell cranks fulcrumed upon yielding springs, gripping shoes and links connecting the bell cranks with the core.

522,277. WINDOW SPRING FOR BURGLAR ALARMS; J. Steiner, Brooklyn, N. Y. Application filed November 4, 1893. A window spring provided with a lever and a circuit spring carrying upon one side of it an insulating disc, and a contact point to make connection with a base, and upon its other side a distance post to hold it at a fixed distance from the lever.

522,286. DYNAMO ELECTRIC MACHINE OR MOTOR; Charles S. Bradley, Avon, N.Y. Application filed October 29, 1893. A dynamo electric machine or motor having its field magnet circuit in series relation to the armature circuit and provided with an electrical connection at a point intermediate of the terminals with the frame. (See illustration.)

522,294. ELECTRIC ARC LAMP; E. and F. W. Heymann, Boston, Mass. Application filed April 14, 1893. A carbon for arc lamps consisting of a block provided with grooves alternately arranged on its opposite faces.

522,302. SELF LOCKING CLEAT FOR ELECTRIC WIRES; E. Nashold, Chicago, Ill. Application filed February 23, 1894. This consists of a block having recesses adjacent to its support and grooves extending obliquely across the cleat, and with a vertical bend therein, and terminating in flaring openings.

522,327. ELECTRIC ARC LAMP; J. F. Kester, Buffalo, N. Y. Application filed November 23, 1893. The combination with the frame and feed mechanism, of a magnet controlling the movement of the frame, rock lever having one arm connected with the armature of the magnet, and a block adjustably secured to the other arm of the lever and connected with the carrying frame.

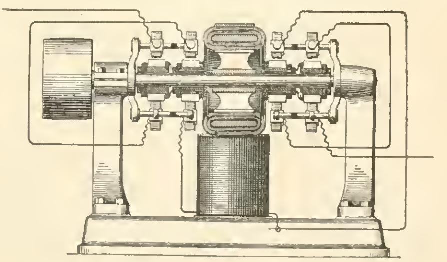
522,332. ELECTRIC SWITCH; John Van Vleck, New York, N. Y. Application filed May 28, 1894. In combination with a three wire distributing system, three pairs of contact fingers respectively connected to the terminals of each conductor, a rotary support, and three circuit closing plates on the periphery thereof; with each of said plates each pair of fingers makes contact, the fingers connected with the neutral conductor of the system being of such length relatively to the fingers connected with the other two conductors as that when said contact plates are moved by the rotation of said support into contact with said fingers, circuit shall be closed through said neutral conductor before it is closed through the remaining conductors.

522,344. ALTERNATING CURRENT MOTOR; John F. Kelly, Pittsfield, Mass. Application filed February 6, 1894. An alternating current motor consisting of an inducing system having, when energized by an alternating current, a symmetrical single phase alternating current magnetic field in combination with a closed symmetrical induced system, the two systems being relatively movable.

522,346. AUTOMATIC FIRE ALARM; C. A. Mann, Buffalo, N. Y. Application filed March 16, 1894. The combination of a base and terminals of a switch spring adapted to connect the contacts on the terminals, a supporting rod in front of the terminals, and a laterally sliding fusion link mounted on the rod and engaging with the switch spring.

522,349. RAIL JOINT AND BOND FOR ELECTRIC RAILWAYS; J. Meyer, New York, N. Y. Application filed October 21, 1893. This comprises a base plate, angle plates connected to the rail ends and to flanges on the base plate, a bond connecting the base of the rail ends, and a filling of asphalt run into the trough of the base plate.

522,356. ALTERNATING CURRENT MOTOR; William Stanley, Jr., Pittsfield, Mass. Application filed April 2, 1894. An alternating current motor, consisting of a field magnet, the energizing coils of which do not coincide as to their average centre with the centre of the figure of their pole piece and the field of which, when energized, is of single or uniform phase, in combination with an induced system symmetrical about an axis, around which one of the members is free to rotate. (See illustration.)



NO. 522,286.—DYNAMO OR MOTOR.

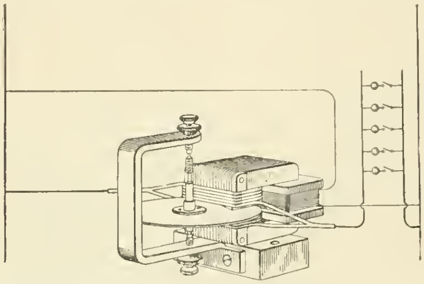
522,362. SUSPENSION CLIP FOR TROLLEY WIRES; W. F. D. Crane, East Orange, N. J. Application filed March 10, 1894. The means for applying a trolley wire clip having opposed hooks, consisting of a handle with projections adapted to engage the upper side of the wire and the under side of the clip.

522,370. DISTRIBUTING BOARD FOR ELECTRIC CIRCUITS; Rienhold Herman, Crafton, Pa. Application filed December 14, 1893. A terminal for a

distributing board having in combination a socket portion provided with a shoulder or flange, a threaded stem, a holding nut and a lock nut fitting on the threaded stem.

522,374. ELECTRIC RAILWAY SUPPLY CIRCUIT: Rudolph M. Hunter, Philadelphia, Pa. Application filed May 8, 1894. In an electric railway the combination of two railway tracks, feeding conductors connecting respectively with the conductor of similar polarity of the two railways, separate generators having their similar poles respectively connected with the two supply conductors, and a common return circuit connecting conductors of other polarity in parallel and in electrical connection with the other terminals of the said generators.

522,388. ELECTRIC RAILWAY SWITCH AND TROLLEY; Frederick S. Perrin, Lynn, Mass. Application filed March 12, 1892. The combination with the trolley wheel of side arms whose upper ends are arranged to extend



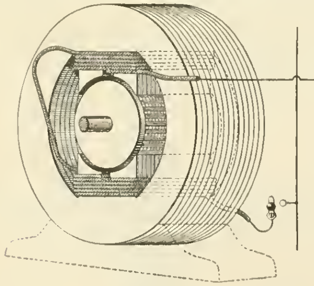
No. 522,345.—PRODUCTION OF CONTINUOUS MOTION BY ALTERNATING CURRENTS.

over the trolley wire, and are movable toward and from each other, and rollers on the ends of said arms, the axes of said rollers being inclined.

522,404. TELEPHONE TRANSMITTER; William R. Cole, Detroit, Mich. Application filed April 30, 1894. The combination with the transmitting diaphragm of a curved spring bar arranged across the diaphragm and carrying one of the electrodes centrally in contact with the diaphragm, the inward movement of the diaphragm tending to straighten the bar, and a bell crank lever against one arm of which one end of the spring bar bears, and a spring bar forming the long arm of the bell crank, and carrying the other electrode bearing against the electrode on the spring bar.

522,428. INSULATOR; Romaine Mace, New York, N. Y. Application filed May 3, 1894. A tubular insulator inserted in an opening in a timber or support and provided with a lug or extension in combination with means for securing said lug or extension to the timber or support.

522,431. ELECTRIC ALARM SIGNAL FOR RAILWAY CROSSINGS; James J. Ross, Detroit, Mich. Application filed April 17, 1894. In an electric railway signal, the combination of two normally closed rail circuits at opposite sides of a crossing, each including a track relay, adapted to be short circuited by the train while passing over the rails of an electric alarm circuit having two branches containing normally open breaks, controlled by the track relays, a controlling relay provided with a main and shunt circuit,



No. 522,356.—ALTERNATING CURRENT MOTOR.

two normally open breaks in branches of the shunt circuit controlled by the track relays, a normally open break in the shunt circuit controlled by the controlling relay, and a normally closed break in the alarm circuit controlled by the controlling relay.

522,440. CONDUIT ELECTRIC RAILWAY; John H. Tyrell, New York, N. Y. Application filed January 23, 1894. The combination with the car of the trolley arm suspended beneath it, a support mounted on the lower end of the arm and adapted to swing relatively thereto and transversely of the car, and a trolley on the said support.

522,454. MACHINE FOR TEACHING TELEGRAPHY; Thomas Mortimer Crepar, Clare, Mich. Application filed March 20, 1894. The combination with the case, the pulleys therein, the circuit breaker and the belt carried by the pulleys and adapted to actuate the circuit breaker, of the hanger having pulleys to carry the outer end of the belt, and the longitudinally adjustable rails supporting the hanger and extending into the case.

522,460. ELECTRIC RAILWAY CONDUIT; Albert T. Fay, Minneapolis, Minn. Application filed April 15, 1894. In an electric railway conduit, the combination with the cross ties and the rails thereon, of the stringers resting upon the tops of said cross ties, surface plates secured upon the tops of said stringers, a slot being left between the inner edges of said plates, a strip of insulating material arranged parallel with said stringers and on the ties, an electric conductor on the top of said strip and the lower part of the conduit, openings being provided between the ties and leading into said lower part.

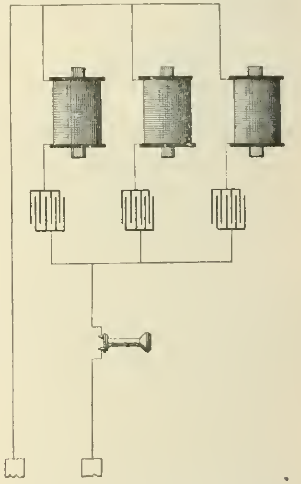
522,461. CONDUIT FOR TROLLEY ARMS; Albert T. Fay, Minneapolis, Minn. Application filed July 26, 1892. The combination with a car of the track for the same, an underground conduit provided with a surface slot, a trolley arm having the thin flattened portion and the yoke to receive the trolley wheel, and a breakable section of weaker metal arranged between the top of the conduit and the car.

522,473. TORPEDO MACHINE OR APPARATUS FOR RAILWAY SIGNALING; Jacob W. Lattig, Easton, Pa. Application filed February 15, 1894. In combination, the pivoted track lever, the upright rod pinned to said lever, the vibratory armature lever carried by the upright rod, the toe or projection against which said vibratory arm acts, the rock shaft on which said toe is mounted, a hammer mounted upon the same shaft and an electromagnet whereby said armature lever may be influenced.

522,479. ELECTRODE FOR SECONDARY BATTERIES; William Morrison, Des Moines, Ia. Application filed April 25, 1894. An electrode for secondary batteries, the body of which is formed by a band composed of a plurality of lead ribbons in close contact throughout, said band being folded and refolded flatwise of the ribbons, and having spaces within the folds to provide for the thickening of the ribbons by the expansion of the lead.

522,500. TELEGRAPH REPEATER; Aldred Dee Pinckney Weaver, Jackson, Miss. Application filed December 26, 1893. A telegraphic repeater, comprising a sounder consisting of the combination of an armature lever, two independent sets of electromagnets, both arranged upon the same side of the fulcrum of said armature lever and both in local circuits, a frame, and a spring contact combined with and interposed between the armature lever and frame, and the circuits and batteries arranged.

522,506. ELECTRIC CONVERTER; George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed November 14, 1893. In an



No. 522,564.—MULTIPLE TELEPHONY.

electric transformer, the combination of two connected standards composed of magnetic material and provided with eyes at their upper ends, a core supported at its opposite ends in said eyes, and primary and secondary coils on said core.

522,507. ELECTRIC CONVERTER, George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed November 29, 1892. An electric transformer having a secondary coil composed of a series of incomplete rings, and a movable brush for completing the circuit of any one or more of said rings.

522,527. ELECTRIC AUTOMATIC CIRCUIT BREAKER; C. W. Larson, Lynn, Mass. Application filed October 17, 1893. This comprises fixed contacts, a sliding rod carrying a bridging contact, a spring, an electromagnet arranged in circuit, a yielding armature carrying a catch, a toggle lever fixed at one end and connected at its other end to the sliding rod, and a hook carried by the toggle lever and adapted to engage the catch.

522,528. ELECTRIC TORPEDO APPARATUS AND SYSTEM FOR RAILWAY SIGNALING; J. W. Lattig, Easton, Pa. Application filed February 27, 1894. This comprises a track circuit and relay, a torpedo apparatus having a break in its exploding mechanism, a magnet controlling the same, and a circuit including the torpedo magnet, a branch circuit, a torpedo track section and connections whereby, by and during the passage of a train over the torpedo track section the branch circuit is put in condition to cause the torpedo magnet to maintain or restore the break in the torpedo exploding mechanism.

522,559. GALVANIC BATTERY; F. Fullner, Chicago, Ill. Application filed August 28, 1893. This consists of a zinc element in a solution of potash, the proportions being substantially one pound of potash to seven quarts of water, and a carbon element in a porous cup containing a solution of sulphuric acid and nitrate of soda, the proportions being substantially four parts of sulphuric acid, three parts of water, and one part of nitrate of soda.

522,564. MULTIPLE TELEPHONY; Maurice Hutin and Maurice Leblanc, Paris, France. Application filed June 1, 1894. The improvement in the art of telephony, which consists in transmitting vocal or other sounds by generating electrical undulations similar in form to the sound waves, and selecting therefrom and charging a line with components of these electrical undulations. (See illustration.)

The Electrical World.

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VOL. XXIV. NEW YORK, JULY 21, 1894. No. 3.

CONTENTS.

AMATEUR MOTOR BUILDING.

The article on amateur motor building, in another column, will be found of interest by those who have the time and opportunity to indulge in the very profitable, from an educational standpoint, pleasure of constructing amateur apparatus. The actual construction of such a model will convey a better idea of the technical principles concerned than a small library of books, and in this case the maker will have the satisfaction of possessing, when completed, a motor of good efficiency, which can be utilized for a fan or for experimental purposes. The directions given are so minute that there should be no difficulty in any one carrying them out, whether with respect to the mechanical construction or the electrical details, which latter will be given in the next section of the article.

ELECTRIC RAILWAY NETWORKS.

Every few months one or more of the New York dailies has an article of some length on New Jersey networks of electric railways, all of which almost seem to be written from the same original copy. Sometimes rumors in regard to a network from Camden approaching to connect with one in Northern New Jersey are elaborated, and the impression likely to be received by the lay reader is that there is something both wonderful and mysterious in these "network" schemes. As far as we can learn, however, towns between which the traffic is likely to be profitable have been connected by electric railways, and the only significance of "networks" is that these lines, on a map, may present such an appearance. If the traffic between towns north of Camden and south of Jersey City is likely to be large enough to justify the construction of lines, they will probably some time meet at Trenton, or some other place, and then we will have what might be called a network system between those extremes; but it does not seem that this implies any strange development of electric traction.

THE ORIGIN OF UPPER HARMONICS.

In another column we print an abstract of the valuable paper read by Dr. Pupin at the Philadelphia meeting of the American Institute of Electrical Engineers, in which, however, only the conclusions are given. Those who would like to know the details of the beautiful method of resonance analysis employed are referred to the original in the *Transactions* of the Institute. The paper has an important practical bearing, for it clearly shows how the presence of the upper harmonics accounts for rupture of insulation of alternating machines, and it is pointed out that lines should be constructed in such a way that conditions favoring resonance with the frequency of the fundamental, or with one of its odd upper harmonics, will seldom occur, or, when they do occur, there will be no resonant rise of potential capable of doing damage. To the same end, slotted armatures and armatures with projecting pole pieces should be avoided, and the magnetization kept as low as possible. Another conclusion of interest is that hysteresis will not, as has been claimed, account for the abrupt cyclic changes which may be the cause of the upper harmonics. The resonance analysis of a rotary field, described in the paper, proves that rotary magnetic fields, if produced by reasonably well constructed machines, are not accompanied by fluctuations in their intensity, which should definitely settle a question which had no reason for its existence.

THEORETICAL VS. PRACTICAL ELECTRICITY.

We have frequently referred in these columns to the dubious advantage of a technical education, in which the teaching of principles is subordinated to purely practical training, and our views receive another confirmation in some remarks by Prof. Ostwald in an introduction to a paper to which we quote elsewhere. He refers

to the fact that the bulk of benzol made in England is exported to Germany, where it serves for the preparation of colors, perfumes and drugs, and then asks the cause that leads to another country obtaining thus the greater share of a profit, all of which might be retained in England where the raw material is produced. The answer he found during a visit to that country, where he learned that the English student has too great a belief in the value of "practical" subjects to waste time in learning pure chemistry. Wishing to become a technically trained dyer, he learns dyeing instead of the chemical principles upon which dyeing depends, and the natural result is that at the first notable departure from the art of dyeing, as he learned it, he is utterly at a loss, and has to begin learning new empirical methods, instead of applying that general knowledge which the technical man, who has studied chemistry before dyeing, has fully acquired. The Professor states that the secret of German industrial success is that Germans have grasped the fact that science is the best practice. That this is true with respect to chemistry there is abundant evidence in the fact that Germany, which pays immeasurably more attention to the teaching and investigation of chemical theory than any other country, also controls the chemical trade of the world, while her chemical graduates find profitable employment the world over.

ELECTRO-DYNAMIC MACHINERY.

Under the above caption we begin in this issue the publication of a series of articles by Houston and Kennelly, in which will be considered the principles underlying the construction and use of apparatus for the production, distribution, utilization and measurement of electrical energy. This series of articles will, we think, be one of the most valuable to the student of any treatise of the kind that has yet appeared, not only from the exceedingly clear manner in which it is written, but from the logical sequence of the subjects, the numerical examples based upon practical data and used as illustrations, and the fact that it will be up to date in all the matters treated. The series will lack a common fault of much technical writing, which too often has no perspective, treating some subjects at much greater length than necessary, while others of importance are passed over, mere whims often appearing to have dictated the choice and arrangement of matter, rather than logical considerations. No attempt will be made in these articles to treat of the actual construction of machines and apparatus, which is a subject that would be out of place where the object is the development of general principles, whose application in most cases is an engineering question in which commercial and other considerations frequently demand notable modifications. The modern tendency is to give an increasing importance to the study of principles, and that this is based upon sound wisdom cannot be denied. The practice of the constructive branches of a profession consists largely, as intimated before, in compromises between conflicting principles, or in modifications to suit given conditions. In other words, principles are the raw material which have to be worked and fitted to meet the requirements of practice. As a consequence, to be successful, one should have a thorough knowledge of the elements he is thus required to deal with, or otherwise he becomes helpless when a new set of conditions presents itself. The object of this series is to teach these underlying elements of the profession of the electrical engineer; not, however, in the language of the mathematician and the physicist, as usually attempted, but in the terms employed by the engineer.

ELECTRO-CHEMISTRY.

In the Digest will be found an abstract of an important German paper, by Prof. Ostwald, in which it is pointed out that electro-chemistry contains possibilities that are startling in their scope. It is asserted that if we had a cell in which electrical energy was produced by the direct oxidation of carbon (not with heat, however), and with an output approaching the theoretical, we would be on the brink of an industrial revolution, compared with which the invention of the steam engine sinks into insignificance. Numerically, as a pound of carbon contains 14,000 heat units, this is equivalent to saying that 5.4 hourly horse power would be obtained from each pound of carbon used in this way. Prof. Ostwald says that the one essential for such a cell is a suitable electrolyte to interpose between the carbon at one end and the oxygen at the other, which will permit the occurrence of the necessary electrical interactions and itself suffer no permanent change. This, of course, offers us no solution, but it is encouraging to have the problem assume a definite shape with definite requirements pointed out, for then the mind has something tangible upon which to bring its forces to bear. While Prof. Oswald thus indicates the direction in which it will be profitable to explore, he also warns against expecting to obtain notable economy in the production of electricity from coal through the intermediary of heat. An apparatus of this kind would be a thermo-dynamic machine, and therefore subject to the law of thermo-dynamic efficiency, which is that the portion of heat energy utilized cannot be greater than the ratio of the working range of temperature to the extreme absolute temperature. Another problem offered to the electro-chemist is the utilization in a storage battery of a metal having a low electro-chemical equivalent. For example, it is shown that, if aluminium were available for this purpose, the weights of the electrodes could be reduced to one-eleventh of their present amount. It seems to be the opinion of Prof. Ostwald that the fundamental problem in electro-chemistry is that of osmotic pressure, as he asserts that a galvanic cell is nothing more than a machine driven by this pressure. While the origin of osmotic pressure is yet a mystery, its existence has been proved by interposing a septum between two solutions, to one of which it is impervious; a solution of sea water, it is stated, thus gives a pressure of 20 atmospheres. It will be seen that the field of modern electro-chemistry is one with boundless possibilities, and would even appear to offer greater inducements to a young man seeking a professional career than any other branch of electrical science. Unlike most of the other branches, however, it involves a theoretical training of the highest order, and is of all the least likely one to prove profitable to the empiric and dabbler.

Judge Ricks' Decision Sustained.

We referred last week to Judge Dallas' decision in the United States Circuit Court at Lancaster, Pa., sustaining Judge Ricks' opinion in the Buckeye lamp case, and we give below the full text:

"This is a motion for a preliminary injunction to restrain the defendant from using certain electric lamps in alleged violation of the rights of the complainants under what is known as the Edison patent for incandescent lamps. The substantial question is as to the weight which should, upon this application, be accorded to the action of the Circuit Court for the Northern District of Ohio, on certan motions made in that court, for, and to dissolve, preliminary injunctions in suits upon the same patent. In disposing of the motions referred to, Judge Ricks' delivered three opinions, which have been discussed at length by counsel, and attentively read by me; but I do not deem it necessary or advisable to express any opinion of my own upon the subjects with which they deal. It is enough to say that he has decided that the lamps now involved could be lawfully made and sold by the defendant's vendor, and, (quoting authorities) the user of a patented article is not liable as an infringer, where he purchased it of a person who had a legal right to sell it. Nothing is now indicated as to the view which may be taken of this case when considered upon pleadings and proofs, but I am of opinion that, because a preliminary injunction against the maker of these lamps has been refused in the Sixth Circuit, this court should not, upon interlocutory application, enjoin the use of them by a defendant who bought them from that maker. The motion for a preliminary injunction is denied."

The Calculation of Alternating Current Motors.

The interesting serial by Mr. E. Arnold on this subject, which has appeared in these columns during the past year, has been reprinted from the "Elek Zeit.," and in pamphlet form by the Polytechnischen Buchandlung, A. Seydel, Berlin. The treatise is there given in full, and developed considerably beyond the point it reached in our columns. Those who have followed the series will undoubtedly be interested in the complete work.

Fort Wayne vs. General Electric.

The Fort Wayne Electric Corporation, in the New York "World" of last Sunday, has an article of more than a page in length devoted to a history of the company and a description of its works, from which we extract the following account of Mr. R. T. McDonald's recent coup d'etat.

The article states that it was known that for some months Mr. McDonald and President Coffin, of the General Electric, had been considering various forms of a contract to be entered into between their respective companies. Mr. Coffin's idea was to close up the Fort Wayne factories and to manufacture their apparatus at Schenectady. Mr. McDonald had in mind three points he was bound to accomplish, and which he would not compromise on.

The first was that he insisted on the General Electric Company guaranteeing the paper of the Fort Wayne Electric Company which he had indorsed. The second was that the minority stockholders, many of whom were Mr. McDonald's friends, and some of whom had bought Fort Wayne stock on that account, should be fully protected. This it was proposed to do by buying their stock and adding it to the already large, though not controlling, holdings of the General Electric Company. The latter company would then own the Fort Wayne outright, and could do with it as it pleased. Mr. McDonald was willing to leave the company under these circumstances, or he was willing to serve the company for one year without salary. The third point insisted on by Mr. McDonald was that the works at Fort Wayne should be kept running. The payroll of the company, as already stated, amounts to about $20,000 a month, and it can be easily seen that this is not a small item to a city the size of Fort Wayne. Mr. McDonald's course throughout these transactions was of a most commendable character. As a business man, he wanted to protect himself; as a friend, he insisted on taking care of the minority stockholders, and as a citizen, he desired to help Fort Wayne all he could.

After numerous contracts had been drafted and considered, the negotiations came to naught, and the matter rested where it had started. Finally, about May 25 last, a meeting was held in New York, at which were present, among others, Mr. Coster, of Drexel, Morgan & Co. and the General Electric Company; President R. T. McDonald and his counsel. At this meeting, Mr. Coster told President McDonald that further negotiation was useless; that the General Electric Company intended to send its own men to Fort Wayne on June 9, when the annual meeting of the Fort Wayne Electric Company's stockholders would be held, and that a Board of Directors satisfactory to the General Electric Company would be elected. This ended the meeting, but it did not take long for President McDonald and his counsel, Mr. Putney, to get their heads together and evolve a scheme to checkmate the General Electric.

With only two weeks before the annual meeting to work in, Mr. McDonald immediately set about getting proxies from his friends among the minority stockholders. He found many such among the ex-officers and employes of the old Thomson-Houston Company. The Thomson-Houston people had come into possession of a large block of stock for the regulator patent, the validity of which they had sustained against Mr. Wood, the Fort Wayne Company's inventor. The par value of Fort Wayne Company's stock was $25 a share. President McDonald owned about 3,000 shares. Among the proxies which he secured were those from ex-President Pevear, of the Thomson-Houston Company, representing 8,000 shares, and from Mr. J. N. Smith, a former director, and at one time the largest stockholder in the Thomson-Houston Company, representing 1,600 shares. Proxies of many other persons were secured. The General Electric Company had about 42 per cent. of the stock. Mr. Coffin had a considerable block, and it was thought that the holdings of the General Electric Company, together with the holdings of others immediately connected with it, would control the election. Thereupon Mr. McDonald made application to the Court for the appointment of receivers.

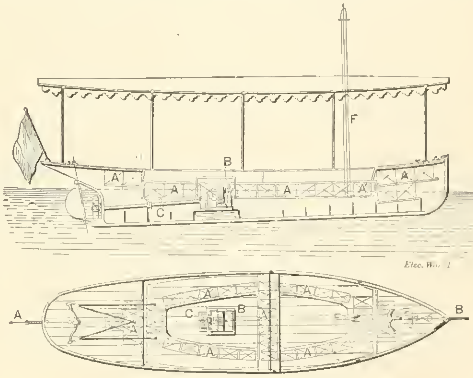
E. J. Hathorne, of Boston, and H. J. Miller, of Fort Wayne, were appointed receivers, and simultaneously came the organization of the Fort Wayne Electric Corporation, which is at present conducting the business. It has made a contract with the receivers to continue the business of the old Fort Wayne Electric Company. Its capital stock is $1,500,000, paid in cash, and the stockholders, who are widely scattered, are practically the holders of the old Fort Wayne stock, with the exception of the General Electric Company. The contract with the receivers has been sanctioned by the courts. The officers of the new Fort Wayne Electric Corporation are: Ronald T. McDonald, president; C. S. Knight, vice-president, and C. C. Miller, secretary and treasurer.

About the first of the year an expert from the General Electric Company went over the books of the Fort Wayne Company and decided that the stock was worth $4.80 per share. The Fort Wayne Company's expert at the same time figured that the stock was worth $6 per share. It is predicted that when the receivers wind up the Fort Wayne Electric Company the assets will be sufficient to meet all the debts and leave a considerable surplus.

New French Electric Launch.

The accompanying illustrations represent an electric launch recently constructed in Paris for use at a pleasure resort on the Mediterranean. The boat is said to be an exceedingly trim little craft, and the trial trips in Paris a few weeks ago are said to have been exceedingly satisfactory from every point of view. The launch is 29 feet 3 inches over all, and it has three feet three inches breadth of beam. Under the seats, which are shown at A in the drawing, and which are designed to accommodate fifteen passengers, is located a battery of 52 accumulators of the Gadot type. The cells are slipped into place at the sides of the seat, the panels being removable. The batteries are contained in wooden boxes carefully sheathed with lead. The tops of the containing cells are closed by lids which press against a rubber gasket. When it is necessary to replenish the liquid it is poured into the cells through openings in the covers which are ordinarily closed by rubber buttons.

The motor, which is installed slightly abaft of amidship, is a Gramme machine of a capacity of 44 amperes at 100 volts. The propeller shaft is driven with a single reduction gear, the speed being reduced in the ratio of 4 to 1. As the armature makes from 1100 to 1200 revolutions per minute, the propeller is driven at the



A FRENCH ELECTRIC LAUNCH.

rate of about 300 revolutions. The pinion on the armature shaft is of rawhide, a material which has been used little for this purpose in France; it is found to be especially useful in this special case, as the noise is found to be much less than if a metal pinion were employed.

The motor is sheltered by a case of varnished wood, and just aft of it sits the operator. He has in front of him the necessary switches, and an ammeter and voltmeter, so that he can at all times keep informed of the state of the accumulators. A rheostat is also provided, but this is seldom used.

To charge the accumulators there has been installed a Gramme dynamo, having an output of 41 amperes and 140 volts. This machine is driven by a two-cylinder vertical gas engine of 20 horse power capacity. The dynamo at the time it charges the 52 cells on the launch also furnishes current to a battery of 56 accumulators which supply 100 16 c.p. lamps arranged about the owner's house.

The charging process occupies about ten hours, and the launch is then ready for a trip of four hours. The average speed, as determined by the tests at Paris, was about $6\frac{1}{4}$ miles per hour.

The weight of the launch, with its cells, is about 10,800 lbs. This is not great enough to prevent the builders from constructing a frame on wheels, or moving the launch from the waterside to a store house.

Practice vs. Theory.

"The secret of the success of the chemical industry in Germany lies in the fact that it has learned that science is the best practice." —Dr. Ostwald.

Electro-Dynamic Machinery.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

I. GENERAL PROPERTIES OF DYNAMOS.

1. By electro-dynamic machinery is meant any apparatus for the production, transference, utilization or measurement of energy through the medium of electricity. Electro-dynamic machinery may, therefore, be classified under the following heads:

(1.) Generators, or apparatus for converting mechanical energy into electrical energy.

(2.) Transmission circuits, or apparatus designed to receive, modify and transfer the electrical energy from the generators to the receptive devices.

(3.) Devices for the reception and conversion of electrical energy into some other desired form of energy.

(4.) Devices for the measurement of electrical energy.

Under generating apparatus are included all forms of continuous or alternating current dynamos.

Under transmission circuits are included not only conducting lines or circuits in their various forms, but also the means whereby the electric pressure may be varied in transit, or the capacity of the line altered between the generating and receptive devices. This would, therefore, include not only the circuit conductors proper, but also various types of transformers, either stationary or rotary.

Under receptive devices are included any devices for converting electrical energy into mechanical energy. Strictly speaking, however, it is but fair to give to the term mechanical energy a wide interpretation, such as would, for example, permit the introduction of any device for translating electrical energy into telephonic or telegraphic vibrations.

Under devices for the measurement of electrical energy would be included all electrical measuring and testing apparatus.

In this series of articles the principles underlying the construction and use of the apparatus described under the preceding heads will be considered, rather than the technique involved in their application.

2. A consideration of the foregoing classification will show that in all cases of the application of electro-dynamic machinery, mechanical energy is transformed by various devices into electrical energy, and utilized by various electro-receptive devices that are connected with the generators by means of conducting lines of various descriptions. The engineering problem involved in the practical application of electro-dynamic machinery can therefore be resolved into the simple case of economically generating a current and transferring it to the point of utilization with as little loss in transit as possible. The best economic conditions under which to solve any particular problem will necessarily depend largely upon the conditions of the case, but, generally speaking, all such problems resolve themselves into a variety of general cases, which will hereafter be discussed.

3. A dynamo electric generator is a machine in which conductors attached to a moving part, generally the *armature*, are caused to cut *magnetic flux paths* under conditions in which an expenditure of energy is required to maintain the motion. Under these conditions, electromotive forces are generated in the conductors.

Since the object of the electromotive force generated in the armature is the production of a current, it is evident that, in order to make the current strength as great as may be desired, either the electromotive force must be increased, or the resistance diminished, as far as practicable.

Electromotive sources must be regarded as producing, not electric currents, but electromotive forces, and, other things being equal, that type of dynamo will be the best which produces, under given conditions of resistance, speed, etc., the highest electromotive force. In designing a dynamo, therefore, the electromotive force of which is fixed by the character of the work it is required to perform, the problem resolves itself into obtaining a machine which will satisfactorily perform its work at a given efficiency, and without overheating.

4. There are various ways in which the electromotive force of a dynamo may be increased.

(1.) By increasing the speed of revolution.

(2.) By increasing the magnetic flux through the machine.

(3.) By increasing the number of turns on the armature.

The increase in the speed of revolution is limited by well-known mechanical considerations. Such increase in speed means that the same wire is brought through the same magnetic flux more rapidly. To double the electromotive force from this cause, we require to double the rate of rotation, which would, in ordinary cases, carry the speed far beyond the limits of safe commercial practice.

Since the E. M. F. produced in any wire is proportional to its rate of cutting magnetic flux, it is evident that to double the E. M. F. in a given wire or conductor, its rate of motion through the flux must be doubled. This can be done, either by doubling the rapidity of rotation of the armature, or by doubling the density of the flux through which it cuts, leaving the rate of motion the same.

Since the total E. M. F. in any circuit is the sum of the separate E. M. Fs. contained in that circuit, if the number of separate wires, each the seat of an E. M. F., be connected in series, the total E. M. F. will be the sum of their separate E. M. Fs. If, therefore, several loops of wire be moved through the magnetic field, and these loops be connected in series, it is evident that, with the same rotational speed and flux density, the E. M. F. generated will be proportional to the number of turns.

An increase in E. M. F. under any of these heads is limited by the conditions which arise in actual practice. As we have already seen, the speed is limited by mechanical considerations. An increase in the magnetic flux is limited by the permeability of the iron—that is, its capability of conducting magnetic flux—and the increase in the number of turns is limited by the space of the armature which can properly be devoted to the winding.

5. It will subsequently be shown that a definite relation exists between the output of a dynamo, either for continuous or alternating currents, and the relative amounts of iron and copper it contains—that is to say, the type of machine being determined upon, given dimensions and weight should produce, at a given speed, a certain output. The conditions under which these relations exist will form the subject of future consideration.

6. Generally speaking, there exists in the case of every machine a constant relation between its electromotive force and resistance, which may be expressed by the ratio, $\frac{E^2}{r}$ where E is the E. M. F. of the machine at its brushes, and r the resistance of the machine; *i.e.*, its internal resistance. In any given machine, the above ratio is nearly constant, no matter what the winding of the machine may be; *i.e.*, no matter what the size of the wire employed.* This ratio may be taken as representing the electrical activity of the machine, on short circuit, in watts, and may be conveniently designated the electrical capability of the machine. For example, in a 200-kw. (200,000 watts) machine—*i. e.*, a dynamo whose output is 200 kw. (about 267 h. p.), the value of its electrical capability would be about 10,000 kw., so that, if its E. M. F. were 155 volts, its resistance would be 0.0024 ohm.

7. Hitherto we have considered the energy absorbed by the dynamo, independently of its external circuit—that is, we have considered only the electrical capability of the machine.

When the dynamo is connected with an external circuit, two extreme cases may arise.

(1.) When the resistance of the external circuit is very small, so that the machine is practically short circuited. Here all the electrical energy is liberated within the machine.

(2.) When the external resistance is so high that the resistance of the machine is negligible in comparison. Here practically all the energy in the circuit appears outside the machine. Between these two extreme cases an infinite number of intermediate cases may arise.

8. By the *output* of a dynamo is meant the electrical activity of the machine in watts, as measured at its terminals; or, in other words, the output is all the available electrical energy. Thus, if the dynamo yields a steady current of 500 amperes at a steady pressure or E. M. F., measured at its terminals, of 110 volts, its output will be $110 \times 500 = 55{,}000$ watts, or 55 kilowatts.

The *intake* of a dynamo is the mechanical activity it absorbs, measured in watts. Thus, if the dynamo last considered were driven by a belt which ran at a speed of 1,500 feet per minute, or 25 feet per second, and the tight side of the belt exerted a stress or pull of 2,500 pounds weight, with the tension on the slack side of 710 pounds weight, the effective force, or that exerted in driving the machine, would be 1,790 pounds weight. This force, moving through a distance of 25 feet per second, would do an amount of work represented by $1{,}790 \times 25 = 44{,}750$ foot-pounds per second; and one foot-pound per second is usually taken as 1.356 watts, so that the intake of the machine is 60,680 watts, or 60.68 kw.

By the *commercial efficiency* of a dynamo is meant the ratio of its output to its intake. In the case just considered, the commercial efficiency of the machine would be $\frac{55}{60.680} = 0.9064$.

*This ratio would be constant if the ratio of insulation thickness to diameter of wire remained constant through all sizes of wire.

By the *electrical efficiency* of a dynamo is meant the output, divided by the total electrical activity in the circuit. Thus, if the dynamo just considered had a total electrical energy in its circuit of 57 kw., of which 2 kw. was expended in the machine, its electrical efficiency would be $\frac{55}{57} = 0.965$.

9. The output of the machine would be greatest when the external resistance is equal to the resistance of the machine. In this case, the output would be just one-quarter the electrical capability, and the electrical efficiency would be 0.5. Thus, the resistance of the dynamo considered above would be 0.008 ohm, and the electrical capability of the machine $\frac{110^2}{0.008} = 1,512,500$ watts, or 1,512.5 kw.; and if the external resistance were equal to the internal resistance—namely, 0.008 ohm—the total activity in the circuit would be 756.25 kw.; the output would be 378.12 kw., and the electrical efficiency 0.5.

That is to say, in order to obtain a maximum output from a dynamo machine, the circumstances are such that half the electrical energy must be developed in the machine and half in the external circuit; or, in other words, the electrical efficiency can be only 0.5. In practice, however, it would be impossible to operate a machine of any size under these circumstances, since the amount of energy dissipated in the machine would be so great that the consequent heating effects would destroy the machine.

10. We have seen that whenever the resistance in the external circuit is indefinitely great, compared with that of the machine, the electrical efficiency of the machine will be 1.0, or 100 per cent. It is evident, therefore, that in order to increase the electrical efficiency of the dynamo, it is necessary that the resistance of the external circuit be made great, compared with the internal resistance of the machine. For example, if the external resistance be made nine times greater than that of the internal circuit, then the electrical efficiency will be $\frac{9}{9+1} = 0.9$; and, similarly, if the external resistance be nineteen times that of the internal resistance, the electrical efficiency would be raised to $\frac{9}{19+1} = 0.95$.

11. Care must be taken not to confound the electrical efficiency of a machine with its electrical output. The electrical output of a machine would reach a maximum when the electrical efficiency was 0.5, or 50 per cent., and the output would be zero when the electrical efficiency reached 1.0.

The electrical efficiency of large dynamos is very high, about 0.985. Indeed, the electrical efficiency of such machines must necessarily be made high, since otherwise the loss of energy within them would cause them to overheat.

The commercial efficiency of a dynamo is always less than its electrical efficiency, since all mechanical and magnetic frictions, such as air resistance, journal-bearing friction, hysteresis and eddy currents come into account among the losses. The commercial efficiency also depends upon the type of machine, whether it be belt-driven, or directly mounted on the engine shaft. It will also vary with the character of the iron employed in its field magnets and armature, and with the care exercised in securing its proper lamination. In large machines, of say 500 kw. capacity, the commercial efficiency may be as high as 0.95. In very small machines, of say 0.5 kw., the highest commercial efficiency may be only 0.65.

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(To be continued.)

Resonance Analysis of Alternating and Polyphased Currents.*

BY M. I. PUPIN.

The method described in this paper of analyzing alternating current waves by electrical resonance is one suggested by Dr. Pupin in a paper which appeared in the American Journal of Science, of May, 1893. The aim of the experiments was to detect the presence of harmonics, to trace their origin, and to study their variations with the variation of the load, and of other elements of the circuit on which these harmonics seem to depend. For the details of the experiments, and of the resonance apparatus employed, the reader is referred to the original paper.

The presence of upper harmonics in an alternating current wave is a fact which deserves careful consideration, both on account of the purely scientific interest which is attached to it, and also on account of the technical bearing of electrical resonance upon the construction of conductors possessing appreciable distributed capacity.

That alternating current and electromotive force waves of a great variety of forms can be produced by properly designing the pole pieces of the field magnet and the iron core of the armature of an alternator is a fact nearly as old as the discovery of electromagnetic induction. Fully as old is also the knowedge that a great variety of alternating current and electromotive force waves can be obtained by means of the induction of an intermittent current.

The first set of experiments to locate the origin of higher harmonics was performed with a 10 h.p. Fort Wayne 8-pole alternator with a smooth core armature and a Stanley 5 kw. transformer. The general conclusion of this group of experiments is summed up as follows:

I. A ferric self-inductance in circuit with an alternator which gives a simple harmonic electromotive force distorts the current by introducing higher odd harmonics, principally the harmonic of three times the frequency of the fundamental.

II. This harmonic (and in all probability all other harmonics) increases at the same rate as the fundamental when the excitation increases, the rate of increase being up to 4,000 C. G. S. lines of force per sq. cm. proportional to the intensity of magnetic induction in the core of the ferric inductance.

III. When this ferric induction is a transformer, then the distortion appears, but not seriously, in the induced secondary electromotive force if the transformer has an open magnetic circuit; it does not appear there to any extent worth considering if the magnetic circuit is a closed one.

IV. A practically simple harmonic electromotive force is produced by alternators with smooth core armatures, even if the machine is worked at considerable degrees of magnetization of the armature core.

Another set of experiments was performed with the same object, using a one-h. p. 16-pole alternator with a Crocker-Wheeler slotted core armature wound for 500 volts, but run at a speed giving 1,500 volts.

The transformer connected with it was of induction coil type, with a cylindrical iron core made up of very carefully insulated thin iron wire. As a result of the experiments made with this apparatus the following conclusions can be added to the above:

V. An alternator with slotted core armature produces a complex harmonic electromotive force in which the upper harmonic of three times the frequency of the fundamental is generally by far the strongest.

VI. The amplitudes of the fundamental and the harmonic increase at the same rate with the increase of excitation; this rate is proportional to the excitation, that is to say, proportional to the magnetization of the armature.

VII. A ferric inductance in circuit with a slotted iron core armature introduces no new harmonics. It seems to strengthen those already existing in the electromotive force, that is odd harmonics, especially the first odd harmonic.

The same conclusions will evidently hold true for alternators of ordinary types, that is alternators whose armature is made up of coils wound on iron cores which are bolted to a cylindrical iron drum common to all of them.

It is a well-known fact that the distortion of the primary current disappears gradually with the increase of the secondary load, that is when the external part of the secondary circuit is a non-self-inductive resistance. The question arises now, what becomes of the harmonics which produce the distortion in the primary when the secondary current increases? To answer this question experiments were performed with the large alternator and 5 kw. transformer, the more important conclusion being that the harmonic which manifests itself in the distortion of the primary current when there is no load in the secondary is present at all loads, if not stronger, then certainly with about the same strength. At full load this harmonic could not possibly be detected by Joubert's method of sliding contact, being so exceedingly small in comparison to the fundamental. This persistence of harmonics at all loads, even when completely hidden by the fundamental wave, holds true also when their origin can be traced to the action of the armature of the generator, as in the case of the machine with slotted iron core armature. In all cases their strength seems to depend upon the mean intensity of magnetization of the magnetic circuits to which they owe their origin and upon nothing else.

Whatever the ultimate meaning of the appearance and the persistence of the odd harmonics in an alternating current wave may be, Dr. Pupin says he is not quite prepared to state with any high degree of confidence. One thing is certain and that is that they are present at all loads with almost undiminished strength.

*Abstract of a paper read before the Philadelphia meeting of the American Institute of Electrical Engineers.

Their presence is hidden by the fundamental wave at heavy loads, but when conditions favoring resonance with any one of them arise, they will certainly come out and do all the mischief they can to the insulation. The self-induction of a motor or that of a closed magnetic circuit transformer has practically no bearing upon the conditions of their resonance. These conditions depend in such circuits solely upon the self-induction of the alternator on the one hand and the self-induction and static capacity of the line on the other. According to the experiments just described, the resonant current is confined entirely to the alternator and the line, the di-electric forming a part of its circuit. These observations will be modified in the case of transformers with open magnetic circuits and their equivalents, that is, closed magnetic circuits possessing considerable magnetic leakage, especially when the conditions of the line favor resonance with the fundamental frequency, this frequency being low; such magnetic circuits possess much less magnetic sluggishness and can influence considerably the conditions of resonance with a low frequency.

It was pointed out that the superposition of harmonics upon the fundamental wave was confined to the primary circuit when the secondary is closed by a non-self-inductive resistance, that is, if the transformer is of closed magnetic circuit type. With an open magnetic circuit transformer the deviation of the primary current wave from the simple harmonic form, due to action of the generator or the transformer or both, is felt more or less in the secondary current also. If, however, the secondary is closed by a ferric self-inductance, then odd harmonics will appear in this circuit also in both types of transformers. In fact, the secondary circuit should now, as far as the harmonics are concerned, be considered as a separate circuit in which the secondary coil of the transformer and the ferric inductance in the secondary circuit play the same part as the armature of the alternator and the transformer play in the primary circuit.

The series of experiments which related to the origin and growth of harmonics in the secondary circuit was exactly the same as the one described above, by means of which the so-called distortion of the primary current was studied. The results were the same. The presence of harmonics is due to the action of the ferric inductance; their strength increases proportionally to the intensity of magnetization of the iron in the ferric inductance. They seem to be entirely independent of hysteresis, that is, if by hysteresis the process be understood by means of which most of the heat is generated in a very finely laminated, well insulated and well annealed iron core, when such a core is subjected to rapid reversals of magnetism. An experiment is then described which seemed to demonstrate that the theory which ascribes the origin of harmonics to the hysteretic action of iron is completely untenable.

While Dr. Pupin does not think that the proper time has arrived for the formulation of a physical theory which will give a complete account of the peculiar behavior of iron, by means of which it superposes odd harmonics upon the wave of a simple harmonic current, yet the view which irresistibly suggests itself to his mind is as follows: Upper harmonics will be generated whenever more or less abrupt changes of the magnetic state in any part of the magnetic field through which an alternating current flows occur. A slotted core armature or an armature made up of coils with iron cores distributed over a drum common to all of them will introduce such abrupt changes. An alternating current motor, especially when it is not of a smooth core armature type, will also cause abrupt changes of magnetism and hence cause strong deviations of the feeding current from the simple harmonic form. But if this view be correct, then every complete cycle of magnetization to which iron is subjected when under the inductive action of a simple harmonic current must be accompanied by some abrupt changes in magnetism, and that, too, whether the mean magnetic intensity of the cycle be large or small. A great many things may be suggested which could account for such cyclic abrupt changes. One thing is certain, and that is, that hysteresis, as commonly understood, will not account for them; for these peculiar abrupt cyclic changes, if they really exist and are the cause of harmonics, are not affected by mechanical vibrations by which, as is well known, all hysteretic effects are influenced very much. But whatever the real theory underlying these upper harmonics may be, the bare fact which the engineers have to face is: There is no cure against harmonics as long as the circuits contain iron. Hence construct your lines in such a way that conditions favoring resonance with the frequency of the fundamental or with one of its odd upper harmonics will seldom occur, and whenever they do occur the resonant rise of potential should not be capable of producing any damage. Avoid slotted armatures and armatures with projecting pole pieces and keep the magnetization down as much as possible.

The closing section of the paper is a description of the application of the resonance method of analysis to the study of the intensity fluctuations of a rotary magnetic field. The method, briefly stated, is this: A suitable number of turns of wire are subjected to the induction of a rotary magnetic field. These turns form part of a resonator. Whatever fluctuations there be in intensity of the rotary field they will be periodic, their period bearing a perfectly definite ratio to the periodicity of the current which produces the rotary field. For instance, in a three-phase combination of alternating currents, the intensity of the rotary field will, according to theory, show six maxima and six minima during each complete revolution, the maxima differing from the minima by about 14 per cent. A circuit subjected to the inductive action of such a field should have a periodic electromotive force induced in it whose frequency will be either three or six times the frequency of the fundamental, according to the shape of the curve of fluctuations. Similarly in a rotary magnetic field produced by a two-phase combination of alternating currents. If such electromotive forces were induced the resonator would detect them, and from the resonant rise of potential the extent of the fluctuations producing these electromotive forces could be estimated.

No electromotive forces of this type were detected in either a triphase or a two-phase combination. Hence the inference: Rotary magnetic fields produced by reasonably well constructed machines are not accompanied by fluctuations in their intensity.

The Meeting of the Canadian Electrical Association.

The next convention of this association will be held in Montreal the latter part of September, and will be one of unusual interest. The date of the convention will, if possible, be arranged to suit the usual fall railroad excursions to Montreal and Quebec. The meetings will be held in Mechanics' Institute, and will extend over three days. The following papers will be read:

"The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Fly Wheel Accumulators of Improved Construction," by Mr. John Galt, Toronto; "A Method of Distribution with Equalization of Potential Difference," by Mr. D. H. Keeley, of the Government Telegraph Service, Ottawa; "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by Mr. W. B. Shaw, Montreal; "Electrolysis," by Mr. J. A. Baylis, Bell Telephone Company, Toronto; "Telephone Cables, their Construction and Maintenance," by Mr. F. J. F. Schwartz, Bell Telephone Company, Montreal; "Alternating Motors," by Mr. L. M. Pinolet, Montreal; and papers by Mr. E. C. Breithaupt, Berlin, Ont., Mr. T. R. Rosebrugh, Lecturer in Electricity, School of Practical Science, Toronto, and Mr. John Langton, Toronto.

The social part of the programme will be looked after by the Montreal Committee, and will include visits to McGill University, the power station of the Montreal street railway, and other electrical works; an excursion to Lachine and down the Rapids; drive to Mount Royal Park; trip over the Montreal Island Railway, and inspection of the docks and ocean steamers, etc., etc.

Seismic, Magnetic and Electric Phenomena.

The current issue of the Seismological Magazine contains an interesting article on "Seismic, Magnetic and Electric Phenomena," by John Milne, Professor of Mining and Geology in the Imperial University of Japan. Perhaps no one is so well qualified to speak upon this subject as Prof. Milne, and consequently his conclusions given below will be read with interest:

"Although in this and other papers I have brought together a considerable number of observations that would lead us to believe that there might be a connection between earthquake and magnetic and electric phenomena; that hypotheses have been formulated to assist in the conception of the possibility of such connection; that a variety of experiments and investigations have been made to test whether earthquakes were preceded, accompanied, or followed by magnetic or electric phenomena, the results obtained do not guarantee the existence of such connections.

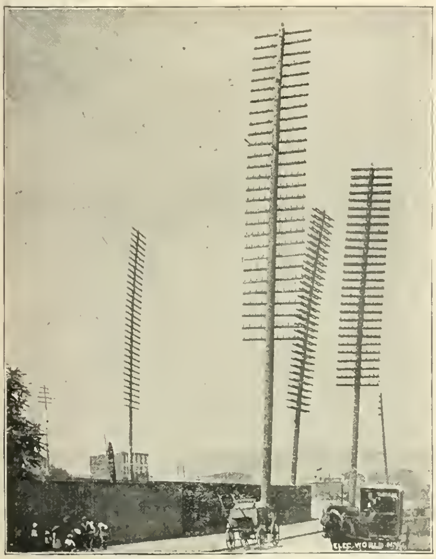
"It does not seem likely that earthquakes can result from electric discharges, and it has not yet been proved that they give rise to electric phenomena. When they have resulted in the displacement of large masses of rocky strata, as happened in 1891 in Central Japan, slight local changes in magnetic curves have resulted, but beyond this and effects due to the mechanical shaking of earth plates, our certain knowledge is exceedingly small."

How the Telephone Company Reaches a Subscriber.

BY W. L. HEDENBERG.

The telephone is in such general use at the present day, not only for business purposes, but for social intercourse as well, that it may be of interest to describe the usual method of reaching a subscriber from a central station, and to point out, at the same time, a few improvements that have recently been made in this city in house-top construction work.

Many of my readers have no doubt visited telephone exchanges, and there seen a number of girls busily engaged in answering calls and connecting different subscribers. The attention of an operator



THE LARGEST POLE LINE IN THE WORLD.

is called to the want of a patron by the falling of a little brass drop. This drop is worked by a small mechanical device, too intricate to discuss at length in this article; and we will simply pass over it with the statement that the subscriber, in ringing his bell, causes a current of electricity to pass through a small coil of wire with an interior core, which core, when electrified, attracts a small lever, and this lever, in moving, allows the above mentioned drop to fall. Consequently, when a person becomes impatient and rings the bell of his telephone long and hard, he does not startle the telephone office by the noise, as he might be led to suppose; the drop simply falls.

The wires are brought to the switchboard in an oval-shaped cable, the ends being fanned out and connected with the various drops. The other end of this cable terminates, in the new exchanges which are now being built in this city, in what is known as an intermediate distributing board. This consists of an iron frame, in which all of the wires are numbered. Another cable starts from the other side of this frame and terminates on one side of the main distributing board. The ends of the two cables just mentioned are connected across the intermediate distributing board by insulated wires. The cable then starts from the main distributing board, being connected with the cable on the opposite side, as in the intermediate board, and next passes through the lightning arresters. At this point the wires of the cable are connected directly with the subway cable, which terminates in a cable head.

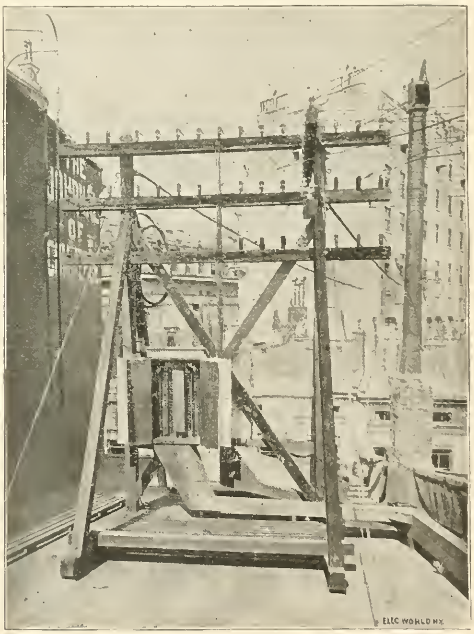
The intermediate distributing board is something comparatively recent, its principal advantage being the ease with which a number of subscribers may be transferred from one operator to another, in case the first operator receives more calls than she can readily answer.

The method of connection just described may seem to be comparatively simple; but the difficulties rapidly increase when there are some 15,000 wires to be looked after, as is the case in the Cortlandt street exchange of the Metropolitan Telephone and Telegraph Company.

Under the streets of New York city, as every one is aware, there is a network of subways. They have all been built in recent years, and others are in course of construction. The New York Board of Electrical Control is steadily forcing all overhead wires and pole lines under ground. By the end of this year no pole lines will exist in New York city, except the great east and west pole lines, the latter being, by the way, the largest pole line in the world carrying twenty-eight cross arms. As soon as a new subway is completed in a street where a pole line exists, the overhead wires are ordered down, and are placed in the subway, in the form of a lead cable. These cables contain usually fifty-one pairs of wires, and are pulled through the three-inch subway iron pipe, called a duct.

The method of drawing a cable through a long stretch of subway between two manholes is quite ingenious. A man stands in the manhole with a bundle of short rods, about three feet in length, with brass ends so constructed that one will fit into another and stand a large amount of pushing or pulling without parting. A rod is inserted in a duct; another one is then clamped on and pushed forward, this process of joining being continued until the first rod appears at the next manhole. The last rod has a small rope fastened to it, the latter being in turn joined to a No. 6 wire, which is made fast to the end of the cable. A man in the second manhole disconnects the rods and draws the rope and wire through. The latter is made fast to a windlass, and by this means the lead cable, weighing about six pounds per foot, is slowly unreeled and drawn through the duct.

We will now go back a step and follow a cable after it leaves the cable head above mentioned. On emerging from the basement of



OLD STYLE LINE SUPPORT.

the central station, it enters a manhole, where it is spliced to another cable having the same number of wires, but running at right angles to it. After each wire has been connected with the corresponding one in the other cable, hot paraffine is poured over the loose wires; a lead sleeve is slipped over the joint, each end of the sleeve being sealed with hot lead, thus making a water and air tight connection with the lead covering of each cable. Great care must be exercised to prevent the wires of the cable from becoming moist or damp, due to poorly connected joints, for there would then be electrical leakage, or the resistance of the wires would be reduced, as water saturated with impurities is a good conductor of electricity.

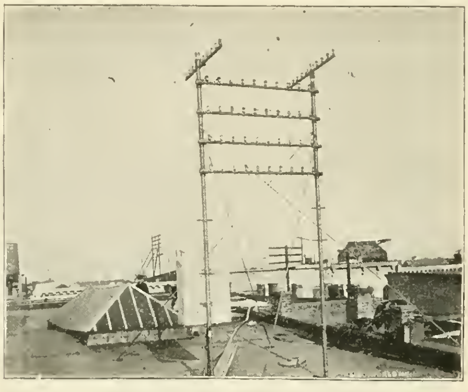
After passing through a mile or so of subway, the cable finally arrives in the district where the wires are to be distributed. A roof privilege is then obtained; or, in other words, the roof of some

high building, centrally located, is rented for a stipulated length of time. A fixture to hold the wires is then placed on the roof.

Until within a short time, the fixture used was of wood, as shown in the illustration. This, however, was found to be clumsy and unsightly, and an advance was made in the adoption of a light iron fixture (see illustration below), constructed of hollow iron pipe. This structure has many advantages over the old wooden one, as will appear later on.

Having reached the house selected, the cable is run up either the front or rear of it, in an iron pipe, to the roof, where it is boxed. It then enters the lower end of the cable box, as shown in the illustration of the wooden fixture. The end of the cable is fanned out, and the wires are fastened to brass binding posts; are then passed through lightning arresters, and finally come out of openings in the right and left-hand lower corners of the box. These wires are called bridle wires, and are heavily insulated. On the wooden fixtures, the bridle wires are taken up to the cross arms in a bunch, then fastened to the glass insulators, and conducted to any desired building in the neighborhood.

With the new iron fixture, the method of procedure is somewhat different. On leaving the cable box, the wires enter an oblong



New Style Line Support.

hole in one of the hollow iron uprights. Passing up the upright, a certain number of wires branch off and pass through each of the hollow cross arms. Near each insulator, and on the under side of the arm, there is a small opening, out of which the bridle wire is drawn, then fastened to the glass and run wherever required. It will thus be seen that the iron fixture has advantages over the older form in having the wires protected from the weather, and being decidedly more sightly in general appearance.

Iron fixtures for house tops have long been in use on the Continent; but until recently there has been a prejudice against their use in this country, owing to the fear that a telephone wire might become crossed with an electric light or other high-voltage wire, and thus be the means of electrifying the whole fixture. This is now remedied to a large extent, however, by the use of a heavily insulated telephone wire. The type of iron fixture which has just been described has been in use, in connection with the telephone plant of this city, for a number of months, and it has proven to be entirely satisfactory. There are now about 160 of them in working order, and additional ones are being erected nearly every day.

Subways are now being constructed throughout some of the principal streets in such a manner that subscribers may be served directly from the ducts, without any overhead wires whatever, so that in the near future even the roof fixtures may be a thing of the past.

A Definition of Darkness.

A German police regulation is said to require that every vehicle must have a lighted lantern from the beginning of darkness, darkness being defined as beginning when the street lamps are lighted. This reminds us of another police regulation in the same country which states that the lamps should not be lighted when the almanac says that the moon ought to shine; whether it is cloudy or not on such theoretically bright nights does not seem to make any difference.

Amateur Motor Building.

BY G. E. DUNTON.

In the following article a complete and clear description is given, with working plans and drawings, of a small electric motor, which any amateur of ordinary ability may be able to construct. The reader is not presumed to have any previous experience in electrical construction, or even any knowledge of electricity. Some of the simple laws, however, that are found in beginners' text books will be of benefit to the amateur, but all descriptions and methods used in these articles will be made so simple and concise that the beginner can, with their aid, understandingly construct an electric motor that will give as satisfactory results as the model described. The only condition presumed is that the amateur has some mechanical knowledge, though not necessarily being a technical machinist; also, that he possesses or has the use of a good engine lathe with jaw chuck that will hold work two and three-quarter inches in diameter, an assortment of drills, a vise and files.

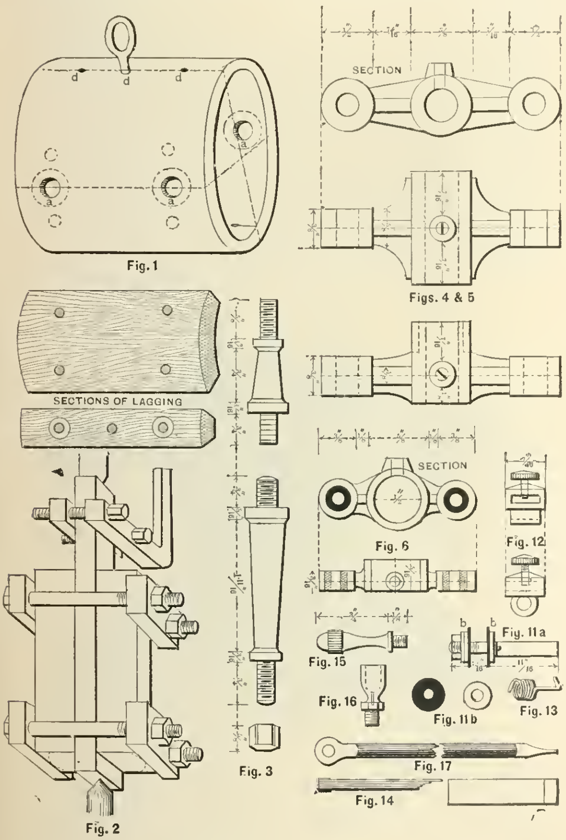
The mechanical part of the construction will first be taken up. From a piece of good wrought iron steam pipe, two and one-half inches internal diameter, cut off a length of two and five-eighths inches. Wrought iron pipe of quarter inch stock will give better results, although the model illustrated is made from pipe of one-eighth inch stock. Put the piece into the lathe chuck, and at very slow speed bore out or turn the inside smooth from end to end, using a stiff diamond pointed tool. One very light cut will give the surface required. Square up both ends, round off the edges, and make the extreme length of the finished piece exactly two and one half inches.

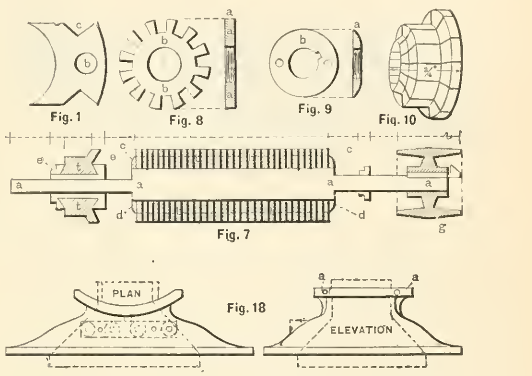
The next step will be to drill the necessary holes in this, which will now be called the "magnet core;" seventeen in all will be necessary, but we will now drill nine only. With a small square butted across the end, draw a line with a scratch awl, down the outside from end to end. Turn the core over and at a point diametrically opposite draw a second line parallel to the first. Particular pains should be taken to have these lines come exact in relative position. Mark off points on each line half an inch from each end and "prick punch" the centres. Four quarter-inch holes may now be drilled on these centres and countersunk for flat head 14-20 machine screws. The pole pieces (see Fig. 1, A) are to be fastened to the core through these holes, so it will be at once apparent that it is important to have them come exactly opposite. We shall now need to draw two more lines, one on each side and exactly half way between the two already drawn. Prick punch on these lines for holes half an inch from each end of the core, and on one line only, a hole in the centre of its length. Drill the five holes, two on one line and three on the other or opposite line, which will be the top of our core. Use a No. 37 drill for these holes as they will be tapped for a 6-32 screw.

The easiest way to make the pole pieces is to make a pattern and have them cast; though unless a steel or wrought iron casting can be procured, they cannot be made nearly as efficient as those shaped from wrought iron. The pole pieces on the model are shaped out of Norway bar iron, and although it takes more time and patience, the writer believes that the builder will feel better satisfied in the end if he uses the wrought iron. From a piece of the best Norway bar iron, one inch by one and one quarter inches and eight inches long, cut into two pieces four inches long. A flat arbor half an inch thick, as wide as our bar (a little wider will do no harm) and about six or eight inches long will be needed. A boring bar will do. The two pieces of iron should now be placed on the opposite and wide flat sides of the arbor and strapped on solidly, putting a piece of tin between each piece and the arbor. Fasten the straps on well out at the ends (see Fig. 2) and do not remove both straps at one time until the pole pieces are fitted to the core finally. In turning up the ends, remove one strap at a time, setting it up into the middle while that end is being turned. Carefully turn down the pieces to a snug fit to the inside of the core. After this has been done nicely, and before the pieces have been taken off the arbor, square up both ends, turning as near down to the arbor as it is safe to run the lathe tool. The teats remaining may be taken off with a hack-saw. The finished length of the pole pieces should be just three and one-quarter inches. After taking them off the arbor, draw a line on each of the rounding sides which have been turning, up and down through the centre of the length and continue it across the ends. On the sides and on this line centre for a hole seven-eighths of an inch from each end; drill these four holes with an eleven sixty-fourths of an inch, or a No. 15, drill and tap out with a No. 14-20 tap. Centre on each end on the line for a hole one-fourth of an inch from the

rounding side, and drill in just five-eighths of an inch, using the same drill, and tap with a 14-20 bottoming tap (see Fig. 1, B).

Before boring out our pole pieces, by planing the sides and also channelling out a V-shaped groove up and down the sides, a better looking job will result, but is not absolutely necessary. The groove should be made one-quarter inch deep at the centre and bevelled flush up to the rounding side, or its edge, and to a line half an inch from the bottom edge. (See Fig. 1, C.) Much of the stock may be also planed from where the bore will be made, thus saving much time. The pole pieces should be firmly bolted into place in the core and numbered, to insure their being returned to the same side after they are taken out. Do not use the machine screws intended for permanent or final use, but find some hexagon cap screws for temporary use. Place the core in the lathe chuck, centre very accurately, and at the slowest speed proceed to bore out between the poles, using a pretty stiff inside diamond tool. The





Details of Motor.

finished bore should caliper one and three-eighths inches, exact diameter. The studs that support the yokes and bearings for the armature shaft are made from a piece of five-eighths of an inch, round, refined iron, one foot long, which is cut into four pieces, making two of them three and three-eighths inches long, and the others two and three-eighths inches long. Each piece is centred and turned up, as shown in Fig. 3, and nicely polished; threads are then cut on the ends of each with a 14-20 die or screw plate.

The best way to make the bearing yokes or hangers, and the only way to insure a neat and finished result, is to make the patterns and have them cast, either of brass or phosphor bronze; if of brass, a phosphor bronze or steel bushing should be put in for the shaft to run in as the motor will have a speed of 3,500 revolutions per each minute, and should have an extra good wearing journal. The entire yoke could not be made from either steel or iron, as it must be some non-magnetic material, but the bushing can be steel. Fig. 4 fully illustrates the front hanger or yoke, and Fig. 5 the back yoke. It will be noticed that the bearing boss or journal is most all on one side of the yoke in Fig. 4; the outside of this will be turned down to allow the brush yoke to swing around on it. The journal on the back or pulley end is longer and more evenly divided on each side of the yoke. (See Fig. 5.) The bosses on the ends should be centred and drilled with quarter inch holes, to allow the ends of the studs, shown in Fig. 3, to pass through easily. To insure greater accuracy in locating these stud holes, with the studs in their respective places in the pole pieces, take the exact measure from centre to centre of the stud ends. Set your dividers to exactly half this measure. Centre the bearing boss, and then with the dividers the centres of the holes for the stud ends can be located very nicely.

The castings should be all finished up smooth, and held in place with some little nuts made from three-eighths inch hexagon iron bar, tapped to the thread on the studs. The little brush yoke casting should also be of brass.

All patterns for small castings the writer makes of lead, such as electrotypers use in their casting, turning out all the bosses and soldering together with bismuth solder; this makes an elegant pattern. The armature will run very snug between the magnet poles, having only three sixty-fourths of an inch total clearance. This will necessitate the bearings being bored perfectly true with the centre of the polar bore, which may be done by drilling a five sixteenths of an inch hole through the centre of the diameter of a cast-iron plug two inches long and one and one-half inches in diameter from end to end. Put the plug on an arbor and turn down to one and three-eighths inches, so it will just fit the polar bore snugly; place this in the bore and drill one hanger at a time through it, mark it and take off. Put the other hanger on its respective end and do the same. Of course the drill is to go through the cast-iron guide first, drilling through the bearing from the inside. In this way the hole cannot fail to centre with the bore of the poles. If the beginner tries to locate these hole centres by measurements, he will find he has quite a difficult task to perform, and very likely not strike it exact after all. The hangers should be put in the lathe on an arbor, and all the bosses faced up nice and true. The outside of the bearing boss on the commutator, or front end hanger, should be turned down to seven-sixteenths of an inch, to allow the brush yoke to slip on over the outside of it. The dotted lines in Fig. 4 illustrate this.

For the armature shaft use a piece of half inch round tool steel eight and one-half inches long. Centre very accurately and turn down to seven-sixteenths of an inch. On the commutator end, for a distance of two and one-half inches from the end of the shaft, turn down to five-sixteenths of an inch. On the pulley end do the same, for a distance of two and five-eighths of an inch from the end of the shaft. (See Fig. 7, A.) In building up the armature core, a washer one and three-eighths inches in diameter, about seven sixty-fourths of an inch thick, and which has a seven-sixteenths of an inch hole, can be purchased at the hardware stores. (Fig. 8, A.) This kind of a washer was used in the model and gives perfect satisfaction, although the writer would recommend the builder to use the thinnest charcoal or Russia stove iron if he is able to shape the washers readily. On each end of the hub, or larger part of the shaft, which should be just three and three-eighths inches long, cut a fine machine thread one-eighth of an inch long, forty to the inch if the lathe will cut this fine. Two

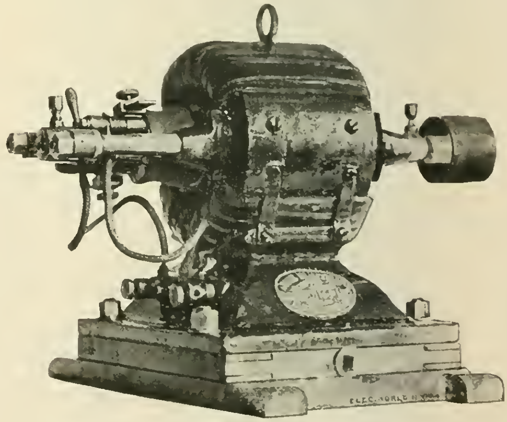
washers, one-eighth of an inch thick, and one inch in diameter, tapped to screw on to this thread on these hub ends will be needed; one edge should be nicely rounded off on one side only. (See Fig. 7, C.)

The armature core may now be built up. Mix up some shellac and lampblack, quite thick; get some thin tissue toilet paper, cut into pieces about one and one half inches square, and punch or cut a seven-sixteenths of an inch hole through the middle. Take the end washers, that have been tapped out, and file a key-way through the thread, one thirty-second of an inch deep and one-sixteenth of an inch wide, also through the thread on the shaft to correspond; drill two one-eighth inch holes in each of the end washers, half way between the edge of the central hole and the outer edge, on a diametrical line through the centre. (See Fig. 9.) This is for the use of a spanner in screwing the washers on. Screw one of the washers on to the shaft tight, bringing the key-ways in line, the rounded side facing the end of the shaft, and drive in a key of

The Armature.

soft iron, filing each end smooth (Fig. 7, D). Slip on over the shaft four sheets of the paper, and paint with the shellac mixture. Then dip one of the larger washers into the shellac and slip it down over the shaft on to the paper. The washer should slide down over the shaft readily and still fit tight. Put on two thicknesses of the paper, dip another washer, bringing it down on to the paper as before, and so on until the core is built up; putting only two thicknesses of paper between each washer, until the last one is reached, and then put in four as at first. This core will require about thirty-two washers besides the two end or set ones. The washers will set down some and should be squeezed up as hard as possible before the end washer is screwed home and keyed. The core should be thoroughly dried out in some gentle heat, but do not heat too much; steam heat is the best. After it is all dry, put it in the lathe and turn down very slowly and carefully to caliper exactly one and twenty-one sixty-fourths of an inch. In the middle of its length, and three-eighths of an inch from each end around the periphery of the core, turn grooves three sixty-fourths of an inch deep, and three-eighths of an inch wide. These are for the armature binders. (See Fig. 7 and also the picture of the finished armature.) The lathe should be fitted with centres that can be attached to the tool carriage in place of the tool rest, one centre being provided with an index and stop. Place the armature between the centres, and with a milling cutter or metal slitting saw, one-eighth of an inch wide on the cutting edge, running in the lathe, mill out twelve grooves or channels up and down the length of the core on its periphery, three-sixteenths of an inch deep and wide as shown in the washer in Fig. 8, B.

The commutator is one of the most particular and trying parts of the entire motor to make and get perfect. Most writers describe a commutator that in practice is worthless. The one herein described is one of the best, if the builder will only have the perseverance to construct it properly. The shell or sleeve is turned from a piece of seven-eighths inch round brass bar; cut off a piece one and one-eigths inches long, and drill a five-sixteenths of an inch hole through the centre of its length. Put this on the arbor and turn down to a diameter of half an inch, leaving a shoulder or hub on one end thirteen-sixteenths of an inch in diameter by one quarter wide or deep. (See Fig. 7, E.) This hub should be turned beveling from its outer edge in to the sleeve, one-eighth of an inch on the sleeve. On the other end of the sleeve a No. 24 thread should be cut one quarter of an inch from the end. A brass collar must now be turned out, thirteen-sixteenths of an inch in diameter, one quarter of an inch wide, concaved or bevelled on the inner side the same as the hub of the sleeve, and tapped out with a No. 24 thread to screw on to the end of the sleeve. A neat little hexagon nut may be shaped on the outer end, being careful not to file in more than one-sixteenth of an inch; or two one-sixteenth inch holes may be drilled on this end for a spanner to use in setting it up. (See Fig. 7, E.) In making the bars or segments of the commutator, it will be found much easier to proceed as follows. From a one and three-eighths inch round bar, cut off a piece to finish up three-quarters of an inch in length, and drill a hole five-eighths of an inch through the centre of the length. Put on an arbor and turn down to one and one quarter inches in diameter. Square up the ends to make the finished length three-quarters of an inch. On each end shape a bevelled lip or flange, projecting from the end, with its bottom resting on the arbor. (See Figs. 7, F, and 10.) This beveled flange should be one-eighth of an inch deep, and three thirty-seconds of an inch long on the under side (on the arbor). Again turn the face of the piece down to a diameter of one inch, leaving a hub projecting radially on one edge three-sixteenths of an inch wide; turn a slight groove around the middle of this hub one thirty-second of an inch deep by one-sixteenth wide. When the ring is sawed into segments, this hub will form the lugs into which to solder the wires coming from the armature. Divide the ring into twelve equal parts around its circumference, and with a hack-saw saw down through the divisions nearly to the central hole, but not quite separating the bars. With the very finest saw that can be obtained (a bracket saw will do very nicely), saw a slot down through the middle of each lug (one thirty-second of an inch deep), into which the ends of the commutator wires are to be soldered. The bars may now be separated, and the rough surfaces, where they were sawed apart, smoothed off with a file. In putting the commutator together, cut out two rings of fibre one thirty-second of an inch thick and seven-eighths of an inch in diameter, and cut a half-inch hole in the centre. Then soak them in warm water for about twenty minutes, when the fibre will become perfectly pliable. Cut some pieces of mica the shape of the bar to go in the spaces between the bars that have been sawed out. A thickness of one good heavy piece of mica or one sixty-fourth of an inch between each bar will do. Put one of the fibre washers on over the brass sleeve, pressing it well down into the groove. Cut a strip of thin asbestos paper exactly as wide as the



The Completed Motor.

commutator bar is long on its bottom, and wrap twice around the brass sleeve, butting snug up against the fibre collar. The bars, with a thickness of mica between each, may now be put in place around the paper and two or three turns of fine wire wound around the outside of the bars to keep them from failing apart. Put on the other fibre washer, screw on the end washer (the brass collar) and set it down firmly (See Fig. 7, F). Test each bar with its neighbor and also each bar with the brass to see that there is no short circuit anywhere. If proper care has been used it will be perfect. Should there be a short circuit found, however, it must be located and the cause removed. The little commutator when all completed should be just one inch long. The material of which the bars are made should be phosphor bronze or tempered copper; either common bar copper or brass is not fit. The segments of the commutator in the model are made from a piece of cast steel. This has been in use almost daily for over a year and is as smooth at this writing as the day put on; it has not been turned down or smoothed off once during that time. The commutator may be keyed on to the shaft or have a one-sixteenth inch set screw go through the end collar and the sleeve into the shaft. Set the commutator with its front end seven-eighths of an inch from the end of the shaft. (See Fig. 7.)

The construction of the brush holders and studs will give the amateur an opportunity to display his ingenuity. Drill a hole

through the centre of the boss on each end of the brush holder yoke three-sixteenths of an inch, and plug with hard rubber or fibre; finish off smooth with the face of the boss, then centre and drill a one-eighth of an inch hole through the centre of each plug. (See Fig. 6.) Make four fibre washers five-sixteenths of an inch in diameter, and one thirty-second of an inch thick, and drill an eighth of an inch hole through the centre of each. Four brass or copper washers, one-quarter of an inch in diameter, one thirty-second thick, with a one-eighth hole drilled through the centre of each. Small copper rivet burrs make these very nicely. (Fig. 11, B.) Make the brush holder studs of two pieces of three-sixteenths of an inch round brass rod, one and one-eighth of an inch long; turn down to a diameter of one-eighth of an inch, in a distance of three-eighths of an inch from one end. Cut a 6-32 thread on this extreme end, extending one-eighth of an inch from the end and provide two three-sixteenths hexagon brass nuts, tapped to that thread. (Fig. 11 A.) Put one of the metal washers on the stud, then a fibre washer. Put the stud through the already insulated hole in the end of the brush yoke, then put on another fibre washer, then a metal one, and screw the nut on. The end of the brush cable goes on, and the tension springs of the brush holders are to be adjusted before the nut is set up finally.

The brush holders are made from half-inch sheet or bar brass, as shown in Fig. 12, drilled with a three-sixteenth hole to go on over the studs, mortised out five-sixteenths of an inch by three thirty-seconds of an inch, with a small thumb screw through the top to hold the brushes in place. The uniform tension is given the brush by an eight turn coil of No. 24 brass spring wire, slipped on over the stud between it and the yoke. One end passes through a small hole drilled through the stud for it, and the other is bent around the under side of the brush holder. The brushes are made of very thin stencil copper, eight-ply, one and one-half inches long, one-sixteenth of an inch thick and nine thirty-seconds of an inch wide. (See Fig. 14.) The wearing end should be cut to the shape of the commutator, and the butt end have a short lap bent round its end and soldered.

The brush yoke must have a set or check screw; shape this out of a piece of three-sixteenths of an inch brass rod seven-eighths of an inch long. Cut a 6-32 thread on the end, extending one-eighth of an inch from the end to screw through the little boss on the top of the brush yoke, which should be tapped out for it. (See Fig. 15.) The oil cups are turned from five-sixteenths of an inch round brass rod, are three-quarters of an inch long, and have a 6-32 thread to screw into the little bosses on the upper side of the bearings, which should be drilled and tapped out for them. (Fig. 16.) The cables connecting the brushes with the fields are made from ordinary flexible lamp cord, each a single strand four inches long, the ends cleaned of their covering and fitted into pieces of small fish rod ferrule one-half inch long; the ends are flattened, then soldered, and a one-eighth inch hole drilled in each. (Fig. 17.)

The best way to make a pulley is to turn it out of a piece of round cast iron, one and one-half inches in diameter, and one and one-quarter long. Drill a five-sixteenth hole through the centre of its length and put it on an arbor. It is a very easy matter to turn it to the shape shown in section in Fig. 7, G. Cut a key-way in the pulley and shaft one-sixteenth of an inch wide, and one thirty-second deep in each, and key on with a nicely made iron key.

The construction of the base will depend on the use the motor is to be put to. If wholly for a fan motor, a taller base will be necessary. A light standard with spreading feet at the base would be very good. If to supply motive power, through a belt or gear, a base like that on the model will be the best. (See cut of the complete motor.) The pattern is made from a piece of two inch pine plank, five and three-quarters of an inch long and four and one-half inches wide at the bottom. The pattern must be in halves, split up and down throughout the centre of its length from bottom to top and have core prints at the top and bottom, as the base must be hollow. The dotted line in Fig. 18 shows this. Four three-eighths of an inch holes are drilled through the front side of the casting and bushed with hard rubber tube. A piece of fibre two and one-half inches long, one-half inch wide, and one quarter inch thick, mortised into and screwed to the casting over the insulated holes, holds the binding posts and field armature connections. Drill two holes at points on each side, and tapped out for a 6-32 threaded machine screw. Make out of black walnut two sections of lagging two and one-half inches long, two inches wide and one quarter of an inch thick, shaped to fit the periphery of the core nicely, and to be fastened in place with four machine screws, as shown in the picture of the finished motor. The two lower screws should be a little longer, as one end of the brass straps, holding the motor to its base, is fastened under these. Cut two more pieces of this lagging the same length and thickness as the first two pieces, but half an inch wide. Drill the holes to correspond with the screw holes in the magnet core. The edges should be beveled off radially with the diametrical centre of the core. Make the bottom side only three-sixteenths of an inch wide, and the upper one a full half inch. (See Fig. 1, D.) This practically completes the machine work on our motor, as it cannot be fitted to the base until the field is wound, and a brass collar, which goes on the pulley end of the armature shaft had better be left until the armature has been wound. The next section will take up the electrical details.

(To be continued.)

Practical Notes on Dynamo Calculation.—X.

BY ALFRED E. WIENER.

21. *Running Value of Armature.*

In order to form an idea of the efficiency of an armature as an inductor, its "*running value*" has to be determined.

In forming the quotient of the total energy induced by the product of the weight of copper on the armature and the field density, the number of watts generated per pound of copper at unit field density is obtained, an expression which indicates the relative inducing power of the armature:

$$\rho = \frac{E \times C}{lb_a \times \frac{\mathcal{H}}{20{,}000}} = 20{,}000 \times \frac{E \times C}{lb_a \times \mathcal{H}}; \qquad (54)$$

ρ = Running value of armature in watts per pound of copper, at unit field-density (20,000 lines of force per square inch);
E = Total E. M. F., generated in armature, in volts;
C = Total current, " " " " amperes;
lb_a = Weight of copper in armature, in lbs.; formula (28);
$\mathcal{H}$ = Field density, in lines of force per square inch;

The value of ρ for a newly designed armature being found, its relative inductor efficiency can then be judged at by comparison with other machines. The running value of modern dynamos, according to the kind of armature, varies between very wide limits, and the following are the averages:

TABLE XXXIII.—RUNNING VALUES OF VARIOUS KINDS OF ARMATURES.

Kind of Machine.		Kind of Armature.	Running Value. (Watts per lb. of copper, at 20,000 lines per sq. inch.)
High speed.	Bipolar	Drum	300 to 600
		Ring	200 " 400
	Multipolar	Drum	200 " 400
		Ring	150 " 300
Slow speed.	Bipolar	Drum	150 " 300
		Ring	100 " 200
	Multipolar	Drum	100 " 200
		Ring	75 " 150

22. *Armature Torque.*

The work done by the armature of a dynamo can be expressed in two ways: electrically, as the product of E. M. F. and current strength,

$$W = E \times C \text{ watts};$$

and mechanically, as the product of circumferential speed and turning moment, or torque,

$$W = 2\pi \times N \times T \times \frac{746}{33{,}000} = .142 \times N \times T \text{ watts};$$

W = Total energy developed by machine, in watts;
E = Total E. M. F. generated in armature, in volts;
C = Total current " " " " amperes;
N = Speed, in revolutions per minute;
T = Torque, in foot-pounds.

Equating the above two expressions, we obtain:

$$E \times C = .142 \times N \times T,$$

from which follows:

$$T = \frac{E \times C}{.142 \times N} = 7.042 \times \frac{E \times C}{N} \text{ foot-pounds} \qquad (55)$$

But the E. M. F. generated in an armature can be expressed, compare formula (51), by:

$$E = \frac{K \times \Phi \times N}{P \times 10^8 \times 60},$$

hence:

$$T = 7.042 \times \frac{K \times \Phi \times N}{P \times 10^8 \times 60} \times \frac{C}{N} = \frac{11.74}{10^{10}} \times \frac{C}{P} \times K \times \Phi \text{ foot-pounds} \quad (56)$$

From this follows that in a given machine the torque depends in nowise upon the speed, but only upon the current flowing through the armature, and upon the magnetic flux.

23. Peripheral Force of Armature Conductors.

By means of the armature torque we can now calculate the drag of the armature conductors in a generator, respectively the pull exerted by the armature conductors in a motor.

The torque divided by the mean radius of the armature winding, in feet, gives the total peripheral force acting on the armature; and the latter, divided by the number of effective conductors, gives the peripheral force acting on each armature conductor:

$$f_p = \frac{T}{\frac{\frac{1}{2}d'_a}{12} \times K \times \beta'} = \frac{24 \times T}{d'_a \times K \times \beta'} \text{ pounds.}$$

Inserting in this equation the value of T from formula (55), we obtain:

$$f_p = \frac{24 \times 7.042 \times \frac{E \times C}{N}}{d'_a \times K \times \beta'}$$

$$= \frac{2 \times 7.042 \times \pi}{60} \times \frac{E \times C}{\left(\frac{N}{60} \times \frac{d'_a \times \pi}{12}\right) \times K \times \beta'}$$

or,

$$f_p = .7375 \times \frac{E \times C}{S \times K \times \beta'} \text{ pounds} \qquad (57)$$

f_p = Peripheral force, per armature conductor, in pounds;
$E \times C$ = Total output of armature, in watts;
S = Mean conductor velocity, in feet per minute;
K = Total number of armature conductors;
β' = Percentage of effective armature conductors, see Table XXXII.

A second expression of the peripheral force can be obtained by substituting in the original equation for f'_p the value of T, from formula (56), thus:

$$f_p = \frac{24 \times 11.74}{10^{10}} \times \frac{C}{P} \times \frac{K}{K \times \beta'} \times \frac{\Phi}{d'_a} = \frac{2.82}{10^8} \times \frac{C \times \Phi}{P \times d'_a \times \beta'} \text{ lbs.} \qquad (58)$$

Replacing in this the total useful flux, Φ, by its equivalent, the product of gap area and field density, we find a third formula:

$$f_p \times \frac{2.82}{10^8} \times \frac{C \times d'_a \times \frac{\pi}{2} \times \beta' \times l_a \times \mathcal{H}}{P \times d'_a \times \beta'} = \frac{4.43}{10^8} \times \frac{C}{P} \times l_a \times \mathcal{H} \qquad (59)$$

f_p = Peripheral force, per armature conductor, in pounds;
$\frac{C}{2P}$ = Total current flowing through each armature conductor, in amperes;
l_a = Length of armature core, in inches;
$\mathcal{H}$ = Field density, in lines of force per square inch.

It is on account of this peripheral force exerted by the magnetic field upon the armature conductors that there is need of a good positive method of conveying the driving power from the shaft to the conductors, or vice versa; in the generator it is the conductors, and not the core-discs that have to be driven; in the motor it is they that drive the shaft. Thus the construction of the armature is aggravated by the condition that, while the copper conductors must be mechanically connected to the shaft in the most positive way, yet they must be electrically insulated from all metallic parts of the core. In drum armatures the centrifugal force still more complicates matters in tending to lift the conductors from the core; it has therefore been found necessary to employ driving horns, which either are inserted into nicks in the periphery of the discs, or are supported from hubs keyed to the armature shaft at each end of the core. In ring armatures the centrifugal force presses the conductors at the inner circumference towards the armature core, and thus helps to drive, while the spider arms, by interlocking into the armature winding, serve as driving horns. If toothed discs are used, no better means of driving can be desired.

24. Armature Thrust.

If the field frame of a dynamo is not symmetrical, which is particularly the case in most of the bipolar types (see Figs. 22 to 31), unless special precautions are taken there will be a denser magnetic field at one side of the armature than at the other, and an attractive force will be exerted upon the armature, resulting in an armature thrust toward the side of the denser field.

The force with which the armature would be attracted, if only one half of the field were acting, in absolute (C. G. S.) units, is:

$$f_1' = 2\pi \times \frac{G'}{2} \times \left(\frac{\mathcal{H}'_1}{4\pi}\right)^2 = G' \times \frac{\mathcal{H}'^2_1}{16\pi} \text{ dynes;}$$

G' = Gap area, in square centimeters;
$\mathcal{H}_1'$ = Field density, in lines of force per cm^2.
Or, in English measure, 1 square inch being equal to 6.45 $cm.^2$, and 1 pound equal to 444,980 dynes.

$$f_1 = \frac{6.45 \times G \times \left(\frac{\mathcal{H}_1'}{6.45}\right)^2}{16\pi \times 444980} = 7 \times 10^{-9} \times G \times \mathcal{H}_1^2 \text{ pounds} \qquad (60)$$

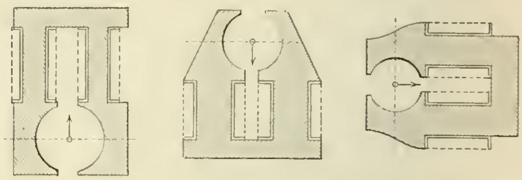
G = Gap area, in square inches;
$\mathcal{H}_1$ = Field density, in lines of force, per square inch;

Expressing the gap area, G, by the dimensions of the armature, we obtain:

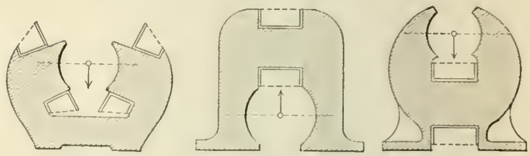
$$f_1 = 7 \times 10^{-9} \times \frac{d_a \times \pi}{2} \times l_a \times \beta' \times \mathcal{H}_1^2$$

$$= 11 \times 10^{-9} \times d_a \times l_a \times \beta' \times \mathcal{H}_1^2 \text{ pounds} \qquad (61)$$

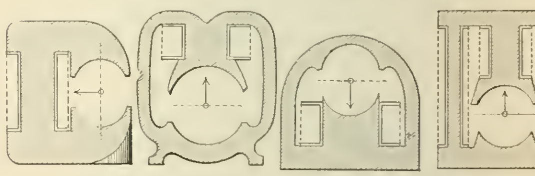
If, now, both halves of the field are in action, but one half is



FIGS. 22, 23 AND 24.



FIGS. 25, 26 AND 27.



FIGS 28, 29, 30 AND 31.

stronger than the other, the armature will be drawn towards the stronger side by the amount of the difference of their attractive forces. The armature thrust, therefore, is:

$$f_a = f_1 - f_2 = 11 \times 10^{-9} \times d_a \times l_a \times \beta' \times (\mathcal{H}_1^2 - \mathcal{H}_2^2) \text{ pounds} \qquad (62)$$

f_a = Attracting force acting on armature, due to unsymmetrical field, or armature thrust, in pounds;
d_a = Diameter of armature core, in inches;
l_a = Length " " " " "
β' = Percentage of effective gap circumference, see Table XXXII.;
$\mathcal{H}_1$ = Density of field, on stronger side, in lines of force per square inch;
$\mathcal{H}_2$ = Density of field, on weaker side, in lines of force per square inch.

In such types, where the attracting force of the field manifests itself as a downward thrust, as in those shown in Figs. 23, 25, 27 and 30, the value obtained by (62) is to be added to the dead weight of the armature, in order to obtain the total down thrust upon the bearings. If, however, f_a is an upward thrust, as is indicated in Figs. 22, 26, 29 and 31, the down thrust upon the bearings is the weight of the armature, diminished by the amount of f_a. In the cases illustrated by Figs. 24 and 28, the action of the field causes a sideward thrust, which has to be taken care of by a proper design of the bearing pedestals, or of the journal brackets.

(To be continued.)

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING.

ELEC. WORLD, N.Y.

ELECTRO-PHYSICS.

Phosphoresence.—A chemical society paper by Mr. Jackson is mentioned in the London "Elec. Eng.," June 29. In many cases it cannot be ascribed to impurities; he attempts to show that fluorescence, phosphorescence in air on exposure to light, and phosphorescence of substances in a vacuum under the influence of electric discharge, are of the same nature, namely, a response on the part of the substances to the operation of radiant energy propagated like light in undulations of short length; some substances require very short undulations to which air is opaque, and they therefore phosphoresce in high vacua; the results of a very large number of experiments seem to indicate a close connection between phosphorescence of air and in vacua.

Transforming Mechanical into Electrical Energy.—An Academy paper by Mr. Vaschy is abstracted in "L'Ind. Elec." June 25, and somewhat more fully in "L'Elec.," and "La Lum Elec.," June 30. In the displacing of a conductor in an electric field, he establishes the fact that the work done by the dielectric on the conductor is the transference of the electric energy in the form of elastic energy or otherwise, localized in the volume abandoned by the dielectric; he discusses also the displacement of a dielectric body and of a magnet in a magnetic field.

Hertzian Waves.—A paper by Mr. Zehnder from the "Wied. Ann.," vol. 52, p. 34, is abstracted in the "Elek. Zeit.," June 14. He describes modified apparatus which enable the Hertzian researches to be demonstrated with much greater ease than heretofore. In place of the mirror of sheet metal he uses one made of woven wire, which may be made about one-third as large; the asphalt prisms are therefore also reduced in size; for a current interrupter he finds that the Deprez form answers best.

Magnetization by Hertzian Currents.—The researches of Dr. Birkeland are given briefly in the "Elek. Zeit.," June 14.

Magnetic Deflection of Cathode Rays.—Mr. Leonard's paper, mentioned in the Digest June 16 and 30, is abstracted in the "Elek. Zeit.," June 14, and "L'Ind. Elec.," June 10. A French translation of the article, together with the illustrations, is published in "L'Elec.," June 16.

Conductivity of Gases.—A note on a recently published article is given in the London "Elec. Rev." June 29.

MAGNETISM.

Variation of Hysteresis with Temperature.—A French translation of the complete article by Mr. Kunz, mentioned in the Digest May 12, together with the illustrations and tables, is published in "La Lum. Elec.," June 9.

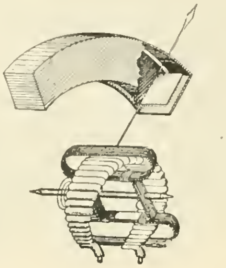
UNITS, MEASUREMENTS AND INSTRUMENTS.

Nomenclature.—In an article in "L'Ind. Elec.," June 25, written undoubtedly by Mr. Hospitalier, he approves very highly of the recent decisions of the American Institute of Electrical Engineers in adopting the names for the magnetic units, and remarks that in a few years these names will be as familiar to the electrician as ohm, volt and ampere. He also expresses approval of the recently adopted definitions, defining the meanings in which the words "inductance" and "reactance" are to be used. He gives a resume of the quantities used in connection with alternating currents, most of which are already well known; among them may be mentioned the following: $\omega = \frac{2\pi}{T}$ called the pulsation or angular velocity of the current, measured in radians per second (radians are numbers for representing angles and are obtained by dividing the arc by the radius), T being the time of a complete period in seconds; u, the difference of potential in volts at any instant t; the subscript *eff* in connection with the letters I, E and U, for the effective values of these quantities; he uses the subscripts s and m with the letter L for self and mutual inductances respectively; ωL_s for reactance of self-induction in ohms; $\frac{1}{\omega C}$ for reactance of capacity in ohms, C being the capacity in farads; $\left(\omega L - \frac{1}{\omega C}\right)$ for the reactance of self induction and capacity expressed in ohms; and $\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$ for the impedance of a circuit in ohms.

Phase Meter.—A paper by Mr. V. Dobrowolski is reprinted in full with illustrations in the "Elek. Zeit.," June 21. After indicating the well-known subdivision of an alternating current into its two components, the effective current and the idle or wattless current, he describes an instrument which is being introduced in Germany for indicating the phase difference; it is really an instrument for measuring the wattless or idle component of the current, but indicates indirectly the phase difference; it not only measures this current but indicates its direction, which is of importance when there is a capacity in the circuit. The apparatus resembles in principle a rotary phase motor and consists of an iron disc pivoted so as to enable it to rotate, containing a spiral spring to bring it to the zero position and provided with a pointer. Around it are placed two fixed coils at right angles to each other, through which the two currents pass; when there is a difference of phase a torque will be produced, which, for a given frequency, is proportional to the product of the currents and the sine of the phase difference; if one of the coils is a fine wire shunt coil and the other a series coil, the instrument will indicate the phase difference between the voltage and the current, and by its direction will indicate which is in advance of the other. If used for the same voltage and frequency the torque will be directly proportional to the idle current; for a small difference in the voltage or frequency the correction will be proportional to the difference. The principal application of the instrument is in central stations with alternators running in parallel, as also in the transmission of power with synchronous motors; when alternators run in parallel there is a current, formerly called a synchronizing current, which it is required to reduce to zero before disconnecting a machine; by means of this instrument it is therefore possible to see whether the alternator is running with any idle current or not, and if so, to indicate when this is zero. A diagram is given showing how this phase meter is introduced on the switchboard for facilitating the connecting and disconnecting of alternators in parallel. In a similar manner, by means of this instrument, the best exciting current can be determined for synchronous motors, thus giving the minimum current in the line wires and thereby reducing the loss in the line to the minimum. In the discussion, Mr. Goerges stated that in his opinion it is preferable to use a wattmeter in central stations in which alternators are run in parallel, as the wattmeter indicates the load on the engine directly; when a machine is disconnected the wattmeter must first read zero; this is the system used with success in a number of installations of the Siemens & Halske Company; he also describes an apparatus consisting of a small electric motor, which acts on the centrifugal governor of the steam engine, reducing the power delivered by the engine without reducing its speed, and used in disconnecting alternators in parallel; he also calls attention to the fact that the phase meter assumes a sine current which is not always correct. In reply, Mr. Dobrowolski believes the phase meter to be preferable for this purpose as it indicates also the direction in which adjustments should be made, while with the wattmeter it is necessary to adjust by trial.

Direct Reading Instruments.—A paper by Dr. Bruger, read before a recent meeting of German electricians, is published in full, together with a number of illustrations, in the "Elek. Zeit.," June 14. He describes some of the recent instruments made by the firm of Hartmann & Braun. The ampere and volt meters are similar in principle to the Weston instruments; the wattmeter differs in principle from the usual form; the construction is shown in the adjoining illustration, which also shows the damping device; by diminishing the cross section of the ring shaped series solenoid toward the ends and by using two fine wire coils, one of

which moves from the middle toward the end, while the other moves from the end toward the middle, a nearly regular scale is obtained; the coils are mounted on agate bearings and the connections are made by means of strips of silver foil, a flat spiral spring acting as the opposing



Direct Reading Wattmeter.

force. To overcome the objections inherent to the spiral spring, he suggests using a quartz fibre, which is stretched in the inside of the coil frame along the centre line of the coil axis, and is so secured that its torsion and its length are adjustable; the self-induction coefficient of the movable coils is about .001 henry; the mutual induction is small as the planes of the coils are parallel and the current circulates in opposite directions in the two coils; the same constant is therefore obtained for alternating as for direct currents. An ohmmeter is described, consisting of two coils at an angle of about 60 degrees with each other, moving in a magnetic field like in a d'Arsonval galvanometer, the polar faces of which, however, are peculiarly shaped, as is also the iron core, so as to produce a field whose density is different in different parts; one form is made for measuring resistance from 10,000 ohms to 1 megohm, but the same instrument can be adjusted for different ranges. A hot wire instrument is also described, modified so as to be used as an ampere meter, the instrument containing a shunt; connections to the wire are made at a number of points so that the different parts are connected in parallel, thus requiring a small difference of potential and therefore a comparatively small shunt; they are constructed for currents up to 500 amperes.

Portable Wattmeter.—A Brillie wattmeter is described and illustrated in "L'Ind. Elec.," June 25. Its principle is the same as usual, it being a zero reading, torsional instrument; in construction it appears to embody a number of improvements; the illustrations explain these; they are constructed to read from 1 to 10 kilowatts.

Mirror Galvanometer.—The London "Elec. Rev.," June 29, contains results of some experiments of Mr. Perkins, showing that it is erroneous to suppose, as is often done, that it is a matter of indifference in what position a mirror galvanometer is set up relatively to the earth's field, and that the needle can always be brought to zero by the adjusting magnet, the sensitiveness remaining the same. The results are given in a table which shows that in two positions the instrument is unstable, it being impossible to bring and keep the spot of light to the zero position on the scale without reducing the sensitiveness considerably; in all other cases the sensitiveness and rate of oscillation could be made substantially the same. Another table is given showing the diminution in sensitiveness when the position of the instrument and the angular position of the magnet were altered, the height of the magnet remaining the same.

Damping.—A mathematical article on the calculation of the damping and the application to galvanometers, from the "Wied. Ann,." vol. 51, p. 156, by Mr. Riecke, is published in "La Lum. Elec.," June 9.

Theoretical Value of the Ohm.—In an Academy paper of Mr. Leduc, published in "L'Elec.," June 30, abstracted in "L'Ind. Elec.," June 25, and mentioned in the London "Elec. Rev.," June 29, he states that the theoretical value is 106.32, which he deduces from a determination of Wuilleumier.

Direct Measure of Electromotive Force.—In an Academy paper by Mr. Limb, abstracted in "L'Ind. Elec.," June 10, and "L'Elec.," June 23, he describes a method for the absolute measurement of the E. M. F. by direct comparison with an E. M. F. of induction, whose value can be calculated; he uses a coil and a permanent magnet revolving in the interior of it; the method and the apparatus are described and some data is given.

Wheatstone Bridge with Alternating Currents.—An Academy paper by Mr. Abraham is published in "L'Elec.," June 30, and abstracted in "L'Ind. Elec.," June 25. He discusses the general cases in which the four arms contain self-induction and the particular case in which one of these self-inductions is zero; if the arms of the bridge are known he shows that the arrangement will enable one to calculate the frequency of the current; some calculated and observed results show a very close agreement.

Synchronizing Clocks for Meters.—In an article by Mr. Jones in the London "Elec.," June 29, he calls attention to an error in meters of the Aron type, in which current is measured by means of the difference in the rate between two clocks; when no current is flowing it is very important that the two clocks should have the same rate, as otherwise they will register a current. He suggests accomplishing this by connecting the two pendulums by a string with a weight attached to its middle point, but as there are attending disadvantages he prefers two small magnets attached to the two pendulums with their unlike poles opposed to each other, their attraction and repulsion will then tend to make the pendulums synchronize; this method is at present used with clocks on about 700 meters of a company in London.

Influence Machine.—In a communication to the French Society of Physics, by Professor Holtz, mentioned in "L'Ind. Elec.," June 25, he claims the priority of invention of the new machine of Mr. Bonetti, as also of the Wimshurst machine, giving references to his first published descriptions.

Rheostat.—The Cance rheostat is described and illustrated in "L'Elec.," June 30; it consists of a spiral of bare wire wrapped around a supporting frame, similar to the old Wheatstone rheostat, and a contact piece which is moved by a crank making contact with any desired point of the wire; the cross section of the wire increases from the high to the low resistance ends.

TRANSFORMERS.

Current Rushes in Transformers.—An article by Mr. Hay on "Impulsive Current Rushes in Inductive Circuits," is begun in the London Elec.," June 29; he investigates theoretically and experimentally the phenomena of the abnormal rushes of current which sometimes occur when a transformer is suddenly switched on to live mains. In the present portion he describes the apparatus which enables him to study the action in detail and trace the various stages through which the current passes before arriving at a steady state; he defines a "current rush" as the ratio of the maximum value reached by the current during any half-wave to the normal maximum when a steady state has been reached; in a comparatively simple mathematical discussion he shows that the current rushes will be greatest when the switch is closed at the instant when the voltage is passing through its zero value and that the current rush, as defined above, must always be less than two; by means of his special switching arrangement, he obtains the actual shape of the current curves, both normal and abnormal; no further results are given in the present portion.

Predetermination of Transformer Curves.—The "Elek. Zeit.," June 21, contains an article by Mr. Korda, on the graphical determination of the current curves of transformers with closed magnetic circuits. The well-known methods of Kapp & Hopkinson assume that certain factors may be neglected and that the specific induction of the iron follows the sine law, which though simpler is not strictly correct. In the present article he gives a general graphical solution of the problem; the article is mathematical in its nature.

Transformer Systems.—The leading editorial in the London "Elec. Rev.," June 29, discusses a system in which transformers are automatically cut out of circuit when not in use; it claims that such a system is only a makeshift and that in good engineering practice the problem is being solved by building transformers having low magnetizing currents at no load, and it believes that transformers exist in which this loss is not more than 1 per cent. of the full load; it is claimed that the scattered small transformer system is a thing of the past and that sub-stations with banked transformers is the correct system.

ARC AND INCANDESCENT LIGHTS.

Arc Lights in London.—According to an official report the number of arc lights used for public lighting in London at present is 479, the length of thoroughfares lighted being thirteen miles; from the number of gas lamps which have been replaced by the electric light, it appears that 2.74 gas lamps are replaced by each arc lamp.

Lewis Arc Lamp.—An illustrated description is given in the London "Elec. Rev.," June 29; the arc is formed and the carbons are fed by the same apparatus, and governed by the same electromagnetic device but the two operations are absolutely independent of each other; a solenoid operates a train of three beveled gears, the feeding apparatus being controlled by a fly escapement, which is locked when there is no feeding.

Cored Carbon Litigation.—The recent decision is given at some length in the "Elek. Zeit.," June 14.

Incandescent Lamp Manufacture.—In the serial of Mr. Bainville in "L'Elec.," he discusses the subjects of the treating of the filaments, the mounting and the production of the vacuum, in the issues of June 9, 23 and 30, respectively.

ELECTRIC RAILWAYS.

Railways and Central Stations.—In a paper by Mr. Hammond, briefly abstracted in the Lond. "Elec.," June 29, he recommends the combination of the power houses of electric railways with the central lighting station; he recognizes that the two loads overlap for a part of the time, and suggests that either accumulators might be used at the station during that time to supply the necessary current in order to level the load line, or that it would be still more economical to use horses for the railways during the overlapping time; in any case he believes that the overlapping difficulty is not insuperable.

Electric Railways in Europe.—According to a paper by Mr. Hammond, abstracted in the London "Elec.," June 29, there are at present in Europe 47 electric roads in operation, the total length being 194½ miles, and the horse power used 14,579.

Budapest Underground Railroad.—A note in the "Elek. Zeit.," June 14, gives some further data about this projected road, regarding the concession but not including any engineering data.

Accumulator Traction.—Some scant data regarding the Sydney line is

given in the Lond. "Elec. Eng.," June 29; Epstein accumulators are used with an output of 20 horse power for five hours.

Wormwheel Gearing.—Some additional remarks regarding the article abstracted in the Digest June 9 and 16, describing Reckenzaun's gearing, are given by Mr. Dawson in the Lond. "Elec. Rev.," June 29.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

High vs. Low Tension.—Mr. Crompton, in a discussion abstracted in the London "Elec.," June 29, strongly advocates the low tension continuous current system in preference to the high tension alternating current system; although the latter requires less capital for the plant this is more than counterbalanced by the higher working costs; he claims that the results in England show this to be the case.

Central Stations in Germany.—A translation of the article mentioned in the Digest June 2, 16, 23 and July 14, together with four full-page tables of data, is given in the London "Elec. Rev.," June 29.

Alternators in Parallel.—See abstract under "Phase Meter."

Bradford.—A paper on the results of four years' working by Mr. Shoolbred, giving a number of curves and tables of data, is reprinted in the London "Elec. Eng.," June 29.

Brussels.—The descriptive article of this station is concluded in "L'Elec.," June 23.

WIRES, WIRING AND CONDUITS.

Insulators.—A novel form of insulator for exposed indoor wiring is described and illustrated in "L'Ind. Elec.," June 10; it consists of a small cylindrical piece of rubber having a transverse hole through it, and a slot enabling a wire to be slipped sideways into this hole; after inserting the wire the insulator is fastened to the wall or ceiling by means of a suitable staple, which encircles the insulator and closes up the gap through which the wire was introduced, thus forming an equivalent of an insulator having a wire passing through a hole through its middle part.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephones in Railroad Service.—According to the "Elek. Zeit.," June 21, the telephone is being introduced largely on the French railroads in place of the telegraph. An Ader microphone, with an iron line wire and earth return, can be used up to distances of 84 miles, but in practice it is not used for more than 30 miles; for this reason copper wires and metallic returns are introduced, the wires being crossed about every 1,600 feet; on the main lines one-quarter of the service is done by telephone, while on many smaller lines the telephone is used exclusively.

Telephone Induction Coils.—Mr. Piérard, in a recent paper on the rendering of telephone induction coils, mentioned in the London "Elec. Rev.," June 29, concludes from experiments, that the rendering of such coils for telephone currents does not vary appreciably with the charge and that the rendering is small and does not appear to reach 50 per cent.

Simultaneous Telegraphy and Telephony.—The Pickernell system is described and illustrated in "La Lum. Elec.," June 9.

ELECTRO-CHEMISTRY.

Electro-Chemistry.—An interesting paper by Professor Ostwald, entitled "The Scientific Electro-Chemistry of the Present and the Technical Electro-Chemistry of the Future," read at a recent meeting in Germany, is published in the "Elek. Zeit.," June 14, a full abstract being given in the London "Elec.," June 29, in which journal it is also discussed editorially and is commented on in the editorial notes. He points out the advantages of a scientific education, claiming that the education of the engineer should be the same as that of the professor and that it is only at the completion of his studies that the student needs to decide which vocation to follow; he believes that the success of the chemical industry in Germany is due to the fact that it is appreciated there that "science is the best practice." He discusses the subject of electrolytes from a theoretical standpoint, and states that in every electrolyte the conductivity is proportional to the number of ions per unit of volume and depends furthermore on two constants, which might be called the velocity of propagation of the ions; the latter is greatest with hydrogen. If a layer of water is poured over a concentrated solution of salt, diffusion will take place until the whole mass is equally concentrated; the cause of this motion, which has the property of a pressure, he calls the "osmotic pressure"; it can be surprisingly great in a solution of salt, like in seawater, a pressure of 20 atmospheres can be obtained; for each material there will be a maximum of this pressure, which will depend on the solubility of the solid body; this pressure is quite analogous to steam pressure, and just as steam pressure can be used to drive an engine, so can osmotic pressure be caused to drive a corresponding machine; he defines a galvanic cell as nothing more than a machine driven by osmotic pressure; the zinc, for instance, is dissolved, forming zinc sulphate; the voltage of a Daniell cell depends on the difference between the osmotic pressures of the zinc and the copper ions; for each metal this pressure, which he calls dissolving pressure, is a perfectly fixed quantity, but a cell does not depend on this alone, but also on the liquid, as for instance on the concentration. He calls attention to the very poor efficiency of the transformation of the energy of fuel into mechanical energy, saying that in the very best case the efficiency is only 10 per cent. He points out the great field for improvement and believes the problem must be solved by electro-chemistry. He describes the following experiments, showing that some of the views held are quite erroneous: Two vessels containing sulphate of potassium are connected by a U tube, one contains an electrode of zinc and the other one of platinum; no current is obtained until acid is added, but it is generally believed that the acid should be added to the vessel containing the zinc, which should be dissolved by the acid; he shows that this is erroneous as no current is obtained under those circumstances, while if the acid is poured in the vessel containing the platinum a strong current is obtained; in this connection he shows that Jablochkoff's recent experiment, in which he obtained a current from the direct combustion of carbon in a battery, was based on wrong principles; he places the carbon in fused saltpetre, and the failure of the experiment is claimed to be due to the fact that the saltpetre should not be placed around the oxidizable electrode, but around that one which is not attacked by the oxygen; in the future carbon cell the oxidizing material will not be placed around the carbon, but around the other pole; in a cell of this sort the chemical process will be the same as in an ordinary stove; what is still wanting is a suitable electrolyte which will merely act as a medium, but will not be consumed; he believes that the solution of this problem is not impossible. Regarding the question of the storage of electrical energy, he shows that if aluminium could be used the weight of an accumulator would be only one-eleventh of that of the lead accumulator but he does not believe that the aluminium accumulator will ever become a practical one. Regarding electrolysis, he does not recommend separating the reactions into primary and secondary, as is often done. In an editorial mention of this paper in the Lond. "Elec.," it is stated that a carbon cell, such as that referred to, should yield theoretically nearly 6 h. p. hours or 4 kilowatt hours per pound of carbon.

Aluminium.—A paper by Mr. Verrier on the present state of the aluminium industry is published in "L'Elec.," June 30, and abstracted in "La Lum. Elec.," June 9. He states that it is hardly probable that the price of this metal will fall below 36 cents per pound when it is made by electrical processes, but that it is possible that cheaper chemical processes will be found; he calls attention to the process based on the reduction of the sulphide of aluminium. (In this conection the compiler calls attention to the fact that there exists a primary battery in which metallic aluminium is obtained as a by-product; possibly some development might be expected in this direction.)

Decomposition of Water.—The Lond. "Elec. Eng.," June 29, mentions a paper by Mr. Leblanc, in which he upholds the view of the primary decomposition of water.

Polarization.—An explanation of the phenomenon of polarization by Mr. Wiedeburg is given in the Lond. "Elec. Eng.," June 22.

MISCELLANEOUS.

Concentration of Sulphuric Acid.—An editorial in the Lond. "Elec. Rev.," June 29, calls attention to a paper in the "Chemiker Zeitung," vol. 17, p. 1,907, in which it was shown that in using the direct current electrolysis took place, producing sulphur and sulphuretted hydrogen, much better results were obtained by using the alternating current; 190 grams of sulphuric acid at 60 degrees C. were concentrated to 65.8 degrees, with a loss of 35 grams in 3.25 hours, the temperature rising and remaining at 286 degrees C; no visible sulphur was deposited; the current was transformed down to 6 to 7 volts and 14 amperes, and the energy consumed for 155 grams of concentrated acid was 296 watt-hours, or 1,490 per kilogram.

Tempered Copper.—"La Lum. Elec.," June 9, extracts from a recent book by Mr. de Rochas a description of the process used by the ancients.

Electric Log.—A translation of the article mentioned in the Digest, June 30, describing Fleuriais's log is published in the Lond. "Elec. Rev.," June 29, including the illustrations.

Biographical.—The death of Edmund Carré is announced in the French journals; short biographical notices are given in "L'Ind. Elec.," June 25, and "L'Elec.," June 30; he was the first to manufacture electric light carbons as usually made by the process invented by his brother, Ferdinand Carre.

Photography.—In color photography the hygrometric state of the plates has an important influence on their sensitiveness; according to "La Lum. Elec.," June 9, a French photographer has obtained good results by an electric process of heating the plates.

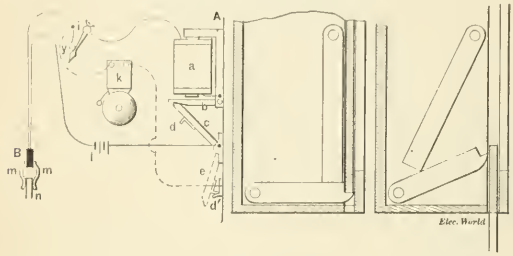
A Simple Fire Alarm.

A New York village of some 9,000 inhabitants (Peekskill), desiring to install an inexpensive system of fire alarm, the apparatus described below was devised by Mr. Louis Miller, Superintendent of Fire Alarms, for this purpose and installed at small cost. The contract with the village required five miles of line through eight districts and connecting the houses of five hose companies, the electric light station, at which there was a whistle to be used for night alarms, and a planing mill where there was a whistle to be used for day alarms; in all 47 signal boxes were required. For indicators, needle annunciators were employed. To ring the local bell it was intended to have the needle close the circuit by contact with its attracting magnet; but this was found to be impracticable and a special instrument, shown in Fig. 1, was designed. It consisted of an electro-magnet, a, and its frame attached to a bar, A (the side of the annunciator), an armature, b, lever, c, pivoted to the base independently of the magnet and armature, and a spring, d, independent of the other devices. The operation of the several parts will be plain. Even a slight impulse through the magnet, a, would lift the armature, b, allowing the lever, c, to fall, and in falling press its spring, d, in contact with spring, d'.

The arrangement of the circuit was as follows: I represents the needle

of the annunciator, and y its attracting magnet, k is the local bell, l the local battery; B is a hard rubber handle furnished with springs, m m, and suspended by flexible cord from the ceiling just over the fire apparatus. The springs, m m, are clasped over some metallic part of the hose carriage, represented by n.

An alarm would cause the needle, i, to make contact with the magnet, closing the local circuit through them, allowing it to pass over the circuit represented by a solid line, through the magnet, a, out of the magnet into the magnet frame and armature, b, through the line, c, thence to the battery. The result would be the dropping of the lever, e, causing it



Figs. 1, 2 and 3.

to make contact with the spring and changing the course of the circuit, cutting out the needle and magnet, a, establishing the circuit through the broken line, which includes the bell, k.

Moving the fire apparatus from its place will cause the handle, B, to swing clear, which will open the battery circuit, there being no longer any occasion for ringing the bell. On the return of the apparatus the annunciator must be tripped before the other instruments in circuit can be reset.

Fig. 4 is an illustration of the signal box. It measured five inches high, three and one-quarter inches wide, and two inches deep. The sides and back were integral and all the box of cast iron. The front was held to the box by a single screw set in from the back, so that when the box was fastened in place with staples over the pipes, the box could not be opened. The front had a hood over the hinge of the drop cover to shed water.

The open front under the drop cover was closed by a plate of glass, inserted by pushing it up through a slot at the bottom, provided between

Fig. 4.—Signal Box.

the front and the box, as shown in Figs. 3 and 4. The glass was easily inserted, but could only be removed by breaking it. Fig. 4 shows how a pair of levers pivoted to the side of the box were manipulated to insert a glass. The lever, a, was pushed back so the lever, b, would yield to the pushing of the glass. When the glass reached its topmost limit the lever, b, would be released and would fall to a horizontal position with its joint under the glass. At the same instant the lever, a, would fall to a vertical position and lock the lever, b, as shown in Fig. 3. The drop front was lettered with directions, thus: "Raise Cover, Break Glass, Press Key."

Within the box illustrated the rubber button of a key is visible. It is a brass key lever, having connection with the insulated wire passing out the pipe at the top of the box. The pipe extended above the box far enough to guard the wire from being tampered with. The key made contact with a spring connected to the pipe attached to the bottom of the box. This pipe extended several feet into the ground, and constituted the "ground" for most of the boxes, although to get a good ground for some of them it was necessary to bury copper plates. The wire from the box extended up the poles to the line, to which it was thoroughly soldered. In the preliminary tests fifteen cells of battery were used, but when put in operating trim the main battery was made to consist of forty cells.

The system worked admirably, the chief objection to it being that the glass of the boxes was frequently broken by mischievous boys and false alarms sent in. This, of course, could be easily remedied by having locked boxes.

The Hamilton Elevator.

The great extent of space required by the present elevator systems in which a single elevator car, while occupying but a few feet vertically,

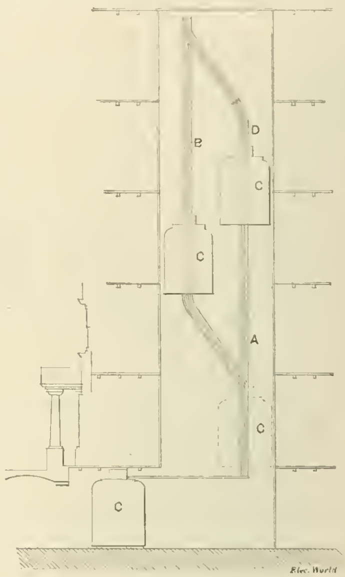


Fig. 1.

monopolizes a shaft running from top to bottom of the building, becomes a serious question in modern office buildings when size compels the use

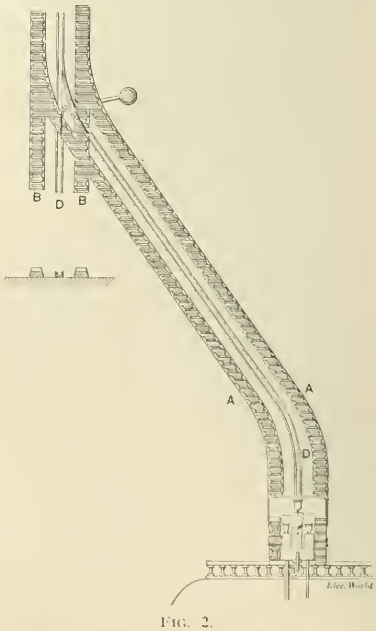


Fig. 2.

of a great number of cars to properly supply the public. Annoyances, perhaps not so serious as the loss of space, but still material, are involved,

though indicators be used, in the confusion resulting from the same shaft having at one time an up-going and the next a descending elevator car. It would obviate all of these annoyances to have all up-going cars in one shaft and all descending cars in another. And the great height of the modern office building allows the adoption of such a method of operation without changing the speed or headway of the cars as they are at

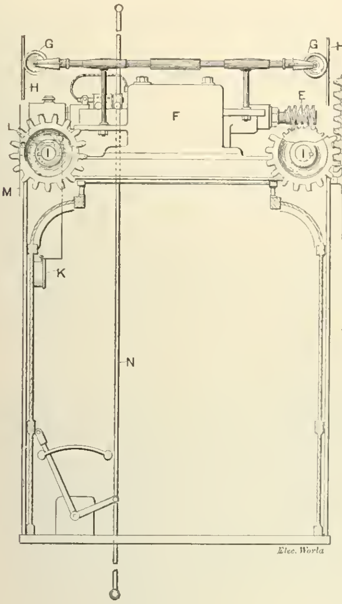


FIG. 3.

present operated. In the system which we illustrate, the invention of John R. Hamilton, 831 East 170 street, New York, the cars all travel up one shaft, and are at the top automatically shifted without stoppage to an adjoining shaft, whence they descend to the lower or ground floor, where they are in a similar manner transferred to the up-going shaft. In

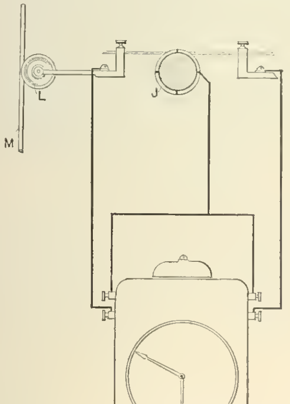


FIG. 4.

each car is an indicator which shows the operator the exact position of the neighboring cars, but sole dependence is not alone placed upon the alertness of the attendant. Electric stopping devices are employed to entirely prevent the possibility of accident from collision. It is found that with ordinary speed, headway and number of cars by the use of this system, two elevator shafts will give the same service as five or more operated according to the old plan, with a large saving in horse power required and great increase of convenience and efficiency in serving the public.

The system, besides, is applicable to freight and mining elevators as well as to passenger elevators, and in its application to mines may be made a valuable adjunct to the mine ventilating devices if the ascending and descending shafts be boxed off so that the elevator platforms will act as air pistons. In the accompanying illustrations Fig. 1 is a view in elevation of an elevator operating on the Hamilton system. Separate racks, A and B, are provided, the former for ascending, the latter for descending cars, C. At top and bottom the racks and the guide tracks, D, are inclined to direct the cars from one side of the shaft to the other. Fig. 2 represents the automatically operating switches for effecting their shifting movement. Fig. 3 shows the mechanism at the upper part of the car. Worm gears, E, are operated by an electric motor, F, which takes current by trolleys, G, from wires, H. The worms on the two sides of the car are pitched in opposite directions, thus doing away with end thrust of shaft. On the countershaft, I, is arranged a circuit breaker, J, connected to the indicator, K, of its own car and by trolley, L, and wire, M, with the indicator of the car ahead. The divergence of the indicator arrows shows the distance in feet or time of the car from the car next ahead, so that the elevator men can maintain a substantially even headway between the cars. A rod, N (Fig. 3), extending both above and below the car, controls the rheostat lever and so governs the motor, promptly stopping the car if it approaches too near another one.

A Diminutive Battery.

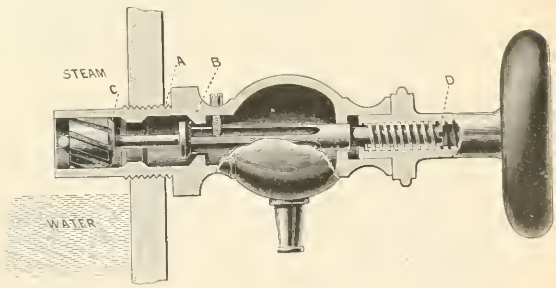
The limit of "multum in parvo" in primary batteries appears to have been reached by the Nassau Electrical Company, 106 Liberty Street, New York, in its new "Capo-Farad" sealed battery, as improved by Mr. J. J. Pearson, manager of the company. The problem of high efficiency, com-

DIMINUTIVE BATTERY.

bined with mechanical reliability and small weight and dimensions, is a very important one, and this cell, shown in the accompanying illustration, which at 1-10 volt yields a current of two amperes, and is only a little over ⅝ inch in diameter, less than 2¼ inches long, and weighs less than one ounce, seems to have solved the question very satisfactorily.

Safety Automatic Gauge Cock.

The gauge cock illustrated, manufactured by Frank M. Ashley, 136 Liberty street, New York, is especially adapted to locomotive and portable boilers, and screws into the boiler or water column as shown. The sectional view shows two valves, and two valve seats in the cock, one behind the other; one valve is cast with the central stem as shown, having a pin projecting from its centre, designed to strike against the face of the second valve. The operation is as follows: Steam being on



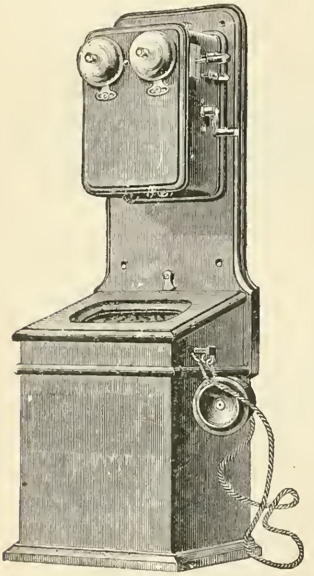
AUTOMATIC GAUGE COCK.

the boiler, the pressure forces both valves to their seats, as shown. To open the valve the handle is turned from right to left, which advances the central stem; then, by pushing the handle in toward the boiler the latter slides inward, forcing the first valve from its seat a short distance, while the pin attached to the back of the first valve strikes the face of the second valve and forces it from its seat. The steam then flows through the spiral wings of the second valve and through the first valve into the atmosphere, causing the second valve to rapidly revolve, and by its action on the spiral wings or flanges cuts loose all scale or sediment which may have lodged in the valve chamber, which is carried off by the steam blowing through. When the engineer lets go of the handle the pressure of steam instantly forces the valves to their seats, but as the second or flanged valve comes to its seat a little before the first valve, and as it is being rapidly rotated by the action of the steam on its flanges, it strikes the seat while revolving and regrinds the valve seats lightly

each time the valves are closed. Another feature is the arrangement of the second valve and its seat. Suppose the gauge cock should be broken off of the boiler by a blow, it would of course break just outside of the boiler sheet, the weakest part, which would leave the second valve within the boiler closed, and consequently the engineer would not be scalded, and if it should happen when his engine was running, he would not have to stop, as it would otherwise be necessary. A screw fits into the groove of the central stem and keeps the stem from revolving. After the valves have automatically closed by the pressure of steam the engineer can screw up the handle which draws the first valve to its seat, so that it cannot be accidentally forced open by being pressed against.

New Telephone Apparatus.

In the accompanying illustration is shown the telephone which the Columbia Telephone Manufacturing Company, 136, 138 and 140 Front street, New York City, is placing upon the market. The instrument is manufactured under the patents of Jas. W. McDonough, H. H. Eldred and other pioneers in the telephone field, and "non-infringement" is one of the strongest claims of the company. The receiver, it will be seen from the cut, is somewhat more compact than the ordinary form, and the connections are made inside the rubber shell, avoiding here, as well as elsewhere on the instrument, the exposure of unsightly thumb screws. A multiple contact carbon transmitter is used, consisting of a series of pencils resting on bearings and having their bearing points rose shaped so as to afford a number of sharp contact points. The carbons are attached to the under side of a thin wooden diaphragm, against which the speaker's voice is directed.



Columbia Telephone.

One of the interesting features is the battery switch. The receiver, when not in use, is suspended on a hook, at the top of which the switch is placed. When the receiver is suspended on the hook an alarm bell rings and can only be stopped by throwing the switch over, a movement which cuts out the battery and prevents its running down. A dry battery is employed. The company is also to bring out in the near future an automatic telephone exchange, by which the subscriber can place himself in connection with any other subscriber, and the ordinary switch board and telephone girl be dispensed with. The means of accomplishing this is exceedingly simple; two electro-magnetic operating ratchets by the attraction of their armatures, secures the necessary movement The apparatus is positive in its action and so simple that it requires little or no attention. In the first form the subscriber made his connections by depressing keys marked "hundreds," 'tens," "units" and "release," respectively; by an ingenious device of Mr. H. H. Eldred, the keys have been replaced by wheels projecting slightly above the containing case, and whose corrugated rims permit them to be easily revolved by the hand, while at the same time figures plainly indicate to the eye whether connection is being made with the proper number. Such an automatic switchboard would find its greatest field of application in the smaller cities and towns, in factories, offices and other places, where the number of subscribers is not sufficiently large to warrant the presence of a day and night central exchange operator.

Trolley Wheel.

A new design of the Westinghouse type of trolley wheel, in which oil is used as a lubricant for the steel spindle in addition to the graphite bushing, is being manufactured by the Ohio Brass Company, of Mansfield, Ohio. The centre of the hub of the wheel is hollowed out around the graphite bushing and the recess filled with felt packing. Holes are provided so that the felt may be kept saturated with oil, which in turn feeds through the bushing to the spindle, keeping the graphite moist and lubricating the bearing thoroughly. It is advisable that a few drops of oil be poured into the oil well every few days. It is claimed that this adds fully 25 per cent to the life of the wheel. The wheels are made from extra hard quality bronze metal and proportioned so as to give the longest possible wear. They are balanced and trued. and in consequence will run smoothly on the trolley wire.

An Automatic Switch for Charging Storage Batteries.

One of the most important adjuncts, if not the most important, to a storage battery plant, is the automatic charging switch, for the most serious results would occur if this instrument should refuse to act at the critical moment. The Electric Bell and Resistance Company, Newark, N. J., has recently placed on the market a new form of automatic switch for this purpose, illustrated herewith, which is claimed to be absolutely reliable, and specially adapted where there are great variations in the voltage of the charging source. The action of this switch is positive and reliable, closing the circuit at any set voltage and opening it when the charging current falls to nearly zero or before it can commence to flow in a reverse direction.

Automatic Storage Battery Switch.

Electric Heating.

A patent has been issued, under date of July 10, 1894, to Mr. H. Ward Leonard, for an electric heater which involves quite a radical change from present practice. The device is perhaps best explained in the first claim of the patent, which reads as follows: "A device in which electrical energy is converted into heat, having a thinly insulated conductor embedded in and completely surrounded by a closely applied mass of metal."

One of the objections to electrically heated tools hitherto has been that the conductor was surrounded by a considerable thickness of fireproof insulation made of various materials which are bad conductors of heat, and the heat developed in the resistance is conducted but slowly through this bad conductor. The conductivity for heat, however, through such insulation would be greatly increased by means of strong mechanical pressure. Another great difficulty has been the gradual deterioration of the heated resistance because of its oxidation by more or less perfect contact with the air through the intervening insulation. The necessity of a resistance which would stand a very high temperature has been such that platinum wire is often used in the construction of electric tools, the

expense of which is of course extremely high, but even this has failed under such conditions.

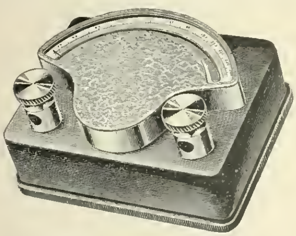
Mr. Leonard has many modifications of the general principles of his invention, but the description of one modification will give a general idea of the invention: The resistance, which is a metal wire, is thinly coated with some form of fireproof insulation which hermetically seals the conductor from the air, such as enamel or glass. The wall of insulation around the conductor is quite thin. The conductor so insulated is placed in a mould, and a suitable metal is cast about the insulated resistance so as to completely embed it in the cast metal. This surrounding body of metal as it cools subjects the insulated conductor to strong pressure, insuring perfect mechanical contact throughout. The surrounding metal also hermetically seals the resistance from any possible contact with the air and from all chemical action. While the insulation surrounding the conductor is of comparatively poor quality as a conductor of heat, the wall of this insulation is so thin that it affords the least possible resistance to the flux of heat from the heated resistance of the surrounding metal body, consequently the temperature of the heated resistance and the temperature at the surface of use will be as nearly the same as possible, and the resistance is therefore not subjected to a temperature appreciably higher than that of the surface of use.

It is possible to operate tools heated by the Leonard system at a bright red head without any destructive effect whatever, and this possibility opens up a wide field for the application of electricity to various tools used in the various arts and industries which have heretofore necessarily been heated by gas, charcoal stoves, etc. The Carpenter Enamel Rheostat Company, of which Mr. Leonard is president, will manufacture apparatus under this patent.

Among the various kinds of apparatus which will soon be on the market due to this invention are the following: All kinds of soldering irons and embossing irons, all kinds of flat irons and tailors' gooses, all kinds of cooking utensils, such as chafing dishes, broilers, griddle cake bakers, coffee pots, electric stoves, electric ovens, egg boilers, etc; also many applications to small appliances such as curling irons, sealing wax heaters, etc. Also all kinds of atmospheric heaters such as street car heaters, and heaters for dwellings where the cost of electric current is sufficiently low to make it possible for electric heating to compete with fuel directly. In this regard Mr. Leonard estimates that where power can be had, which does not cost more per horse-power per annum than the cost of two tons of good coal, electric heating can compete on the score of economy alone with heat from fuel direct, and the many advantages of electric heaters are so pronounced that they will frequently be applied for atmospheric heating even though the actual direct cost be much greater than that due to heating by fuel.

Portable Alternating Current Meter.

A portable instrument, by means of which accurate measurements may be made of alternating currents, is now being placed upon the market by



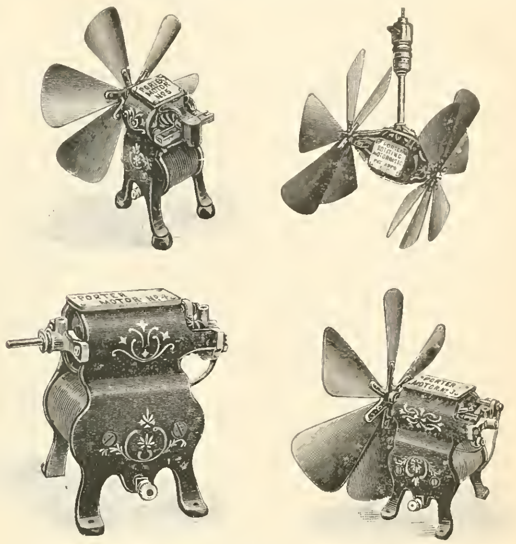
ALTERNATING CURRENT METER.

the General Electric Company. It is small and handy, and combines strength, permanency and reliability with compactness of form and excellence of workmanship. The scale is unusually long and reads to fine divisions. The instrument, although designed for alternating current measurements, may also be used for measuring direct currents, but for this work it requires special calibration. It is made in 25, 50, 100 and 200 ampere sizes.

Small Motors.

It is but a few years since small motors have been made with any efficiency worth speaking of, and among the first who considered the question of economy worthy of study was the Porter Standard Motor Company, now at 35 Broadway, New York. We illustrate herewith some of the latest types of motors manufactured by this firm, including a double rotating overhead ceiling fan motor recently placed on the market.

In order to obtain the best results, a fan motor should be so constructed as to run continuously without attention, and circulate the air in such a manner as to produce the needed relief without discomfort. This is accomplished in the double fan rotating motor, which, if suspended from the ceiling in the centre of a room 40 feet square, will, it is claimed, keep the air in motion in all parts of the room without creating uncomfortable drafts, even in close proximity to the motor, and yet have an effect in the remotest corner. This motor is particularly applicable for use in cooling the cabins of steamships and yachts, and also for ventilating the holds of vessels. It weighs about fifteen pounds, is self-lub-

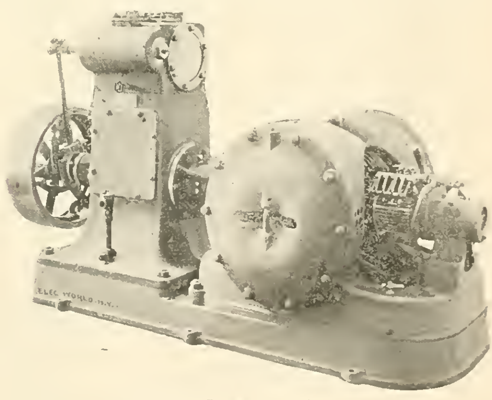


SMALL MOTORS.

ricating, and will run continuously for a whole season without any care. It has 12-inch aluminium fans, and runs at 2,000 revolutions per minute on a 110-volt circuit, requiring, it is stated, less than one-half ampere of current to operate it.

Wenstrom Direct Connected Outfit.

The demand for direct coupled apparatus, especially for isolated plants, is constantly increasing. The greatest hindrance to its introduction in the past has been the high speed at which it has been necessary to drive



DIRECT CONNECTED OUTFIT.

the generator. The Wenstrom Electric Company has devoted special attention to the solution of this problem, and its new outfit, an illustration of which is shown herewith, practically eliminates this difficulty. The Wenstrom dynamo has been familiar to the public for some time and its excellence of construction and high efficiency are well known. A glance at the accompanying illustration will show how admirably it is adapted for direct connection. The dynamo is of multipolar construction and will run successfully at a low rate of speed, for which the Wenstrom Company makes a special claim. The company has recently subjected a 15 kw. outfit to a test which proved very successful and showed good results. Mr. Henry B. Oakman, 136 Liberty street, New York, is the general Eastern agent for the Wenstrom Company.

Financial Intelligence.

The Electrical Stock Market.

New York, July 14, 1894.

THE ELECTRICAL STOCK MARKET has shared with the other speculative markets in the stagnation of business that has resulted from the paralysis consequent upon the big Western labor troubles. While having no direct bearing upon the electrical industry, the strike has completely killed all demand, either for manufactured articles or for securities, and, while large bank funds now on hand after the large July dividend and interest disbursements have sought some temporary investment in securities, the demand is nothing like that which occurs at this period in normal years.

GENERAL ELECTRIC has been the strongest of the low-priced stocks, and, in a market where transactions have been generally absolutely lacking in significance, has been freely taken the last few days by a new pool that has of late been absorbing the floating supply of stock. With the beginning of operations of this pool have naturally appeared a lot of reports tending to increase confidence in the company and to inspire further belief in its renewed march of prosperity. Thus, at the beginning of the week, it was bruited that negotiations were pending between the Manhattan Elevated Railroad Company and the General Electric Company for a plant to take the place of steam motors on the New York system, and though it was afterwards announced that the Manhattan Company had decided not to adopt electricity as a motive power, because of the expense of $8,000,000 involved in making the change, the story had sufficient circulation to strengthen General Electric's quotation. Then it was announced that the General Electric has of late managed to create a demand of large dimensions for power motors from shoe manufacturers in the East, owing to the prevailing disposition among them to save on labor and other details wherever practical, and the opening of this new field of profit has led to calculations as to how General Electric apparatus will be used to great advantage in many industries, thereby assuring a large business to the company. As a result of all these encouraging reports, quite a tone of strength is lent to the stock. But the market is very narrow, and there is no telling how far or how little quotations reflect anything but the manipulation of interested members of some pool or another.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK furnishes The Electrical World, through Treasurer Joseph Williams, some figures of comparative earnings for June, and for the six months ended June 30, 1894. Gross earnings for June were $101,351, an increase of $15,740; net earnings were $52,504, an increase of $18,305. For the six months gross earnings were $687,754, an increase of $77,899, and net earnings were $375 644, an increase of $93,541. With these evidences of prosperity the stock holds very firm.

THE BROOKLYN EDISON ELECTRIC ILLUMINATING COMPANY reports comparative earnings for June as follows: Gross earnings, $24,004, an increase of $3,598; expenses, $17,822, an increase of $4,526; net earnings, $6,182, a decrease of $928; other income, $5,604, an increase of $4,417; amount applicable to dividends, after deducting $2,100 for interest due on bonds, $9,686, an increase of $3,489. The expense account of June, 1894, carries the operating expenses of five weeks, and in addition about $800—incurred in preparing for and lighting on the city contract, from which no revenue appears until July. Net earnings of six months have been: 1894, $96,470; 1893, $72,595; 1892, $43,641; 1891, $22,615.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have, as intimated in these columns last week, purchased, according to agreement, 608 more shares of preferred stock at 97⅞, making the total purchased to date, 12,551 shares. The value of the securities obtained from the General Electric Company and held in the trust is every day being more fully established.

WESTINGHOUSE ELECTRIC issues, with the exception of a good demand for the preferred noted in Boston in the last day or two, have been very quiet, but quotations are very well held on the reports of continued good business.

AMERICAN BELL TELEPHONE stock holds very firm. The Board of Directors of the company held a meeting this week, but it was announced that nothing but routine matters were considered. This, together with the fact that Mr. Hudson, president of the company, is going to Europe, gives rise to the impression that nothing will be done just at present in the matter of issuing the $30,000,000 new capital stock authorized by the Massachusetts Legislature to be sold at auction. But nothing official relative to the matter is made public.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric Co.	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
* Edison Electric Ill., New York	100	100	100½
* " " " Brooklyn	100	100	102
" " " Boston	100	116	115
" " " Chicago	100	135	145
* " " " Philadelphia	100	128	130
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com	15	15	17½
" " " " " pref.	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	37⅛	37½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref.	50	50½	51½

BONDS.

	Par.	Bid.	Asked.
Edison Electric Ill., New York	1,000	106½	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	195	196
American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	—
Gold & Stock Telegraph	100	100	102
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	84⅝	84¾

* Ex. div.

ERIE TELEPHONE AND TELEGRAPH stock has enjoyed some bit of life on the announcement that the telephone service in all its divisions is to be greatly extended.

FORT WAYNE ELECTRIC stock has been higher this week on the belief that the company will yield more in liquidation to stockholders than has been expected. The receivers are making an effort to present at an early date some statement of its affairs.

WESTERN UNION TELEGRAPH has been very firm all week and shorts have been rendered very nervous on finding that the amount of offerings has been largely reduced by the withdrawal from the street of certificates bought by actual investors. The $550,000 additional stock listed on the New York Stock Exchange this week was issued for the purpose of the American Rapid Telegraph Company, which had previously been operated by the Western Union on a lease, but which was purchased under foreclosure on March 11, 1891, by a committee of bondholders, and then resold to the Western Union. With the $500,000 received from the Western Union and with $300,000 in the receiver's hands, the bondholders of the Rapid Telegraph Company will receive a dividend of about 27 per cent. on their $3,000,000 bonds. The $3,000,000 common stock is frozen out. The Rapid Telegraph has 20,370 miles of wire extending from New York city to Boston, Buffalo, Cleveland, Pittsburg, Chicago, Washington and intermediate points, and before being sold to the Western Union was leased to it by the receiver at a rental of $60,000 per year. Dividends of 5 per cent. on $500,000 call for but $25,000 per year, so that the purchase saves the Western Union $35,000 a year.

New Incorporations.

THE JOSEPH TELEPHONE COMPANY, Joseph, Ore., capital stock $500, has been incorporated.

THE MURPHY POWER COMPANY, Chicago, Ill., capital stock $3,000, has been incorporated by S. M. Murphy and others.

THE SPENCER MOTOR COMPANY, Glastonbury, Conn., capital stock $2,000, has been incorporated by S. P. Turner and others.

THE ECONOMIC LIGHT, HEAT AND POWER COMPANY, Snohomish, Wash., capital stock $25,000, has been incorporated.

THE LITTLE CYCLONE FAN COMPANY, Kansas City, Mo., capital stock $10,000, has been incorporated by W. P. Waite and others.

THE ELECTRIC BRUSH PORTRAIT COMPANY, San Francisco, Cal., capital stock $10,000, has been formed to make portraits, frames, etc.

THE BRODIE ELECTRIC COMPANY, Manchester, N. H., capital stock $25,000, has been formed to manufacture electrical apparatus, etc.

THE FREEPORT ELECTRIC COMPANY, Freeport, Ill., capital stock $150,000, has been incorporated by R. S. Brown, J. B. Taylor and Geo. H. Currie.

THE BLUFF CITY ELECTRIC STREET RAILWAY COMPANY, Waukegan, Ill., capital stock $200,000, has been incorporated. The promoters are DeWitt L. Jones, S. D. Talcott and Chas. Whitney.

THE TRACTION CONSTRUCTION COMPANY, Denver, Col., capital stock $50,000, has been incorporated by Geo. E. B. Hart and others to construct and operate electric and cable railways, street railways and tramways.

THE LITTLE CYCLONE FAN COMPANY, Kansas City, Mo., capital stock $10,000, has been formed to operate electric fans, etc. The organizers are W. T. White, F. E. Weidman and Wm. W. McCall, Kansas City, Mo.

THE NASH-EDDY COMPANY, Cleveland, O., capital stock $12,000, has been formed to manufacture and deal in all kinds of mechanical and electrical apparatus, devices, etc. Nathan E. Nash, Geo. A. Eddy, F. G. Botsford, H. W. Wolcott and L. H. Winch.

THE FIRE AND POLICE TELEGRAPH COMPANY, Louisville, Ky., capital stock $50,000, has been formed to deal in electrical machinery, apparatus and supplies, and to do general electrical business. The promoters are C. A. Ray, W. S. Hogue and H. C. Stancliffe.

THE PEOPLE'S GAS AND ELECTRIC LIGHT COMPANY OF SARATOGA SPRINGS, Saratoga Springs, N. Y., capital stock $75,000, has been formed to manufacture and supply gas, electricity and other lights. Chas. H. Moore, H. Carpenter and Warren Dake, Saratoga Springs, are the incorporators.

THE ELBRIDGE ELECTRIC MANUFACTURING COMPANY, Elbridge, N. Y., capital stock $10,000, has been formed to manufacture and sell electrical apparatus and engines, boilers, etc. Wm. C. Ranney, L. B. Doman, A. E. Doman, Elbridge, N. Y., and A. Blair Frazee, Kipple, Pa., are interested.

THE NORTH AND SOUTH ELECTRIC RAILWAY, Yonkers, N. Y., capital stock $50,000, has been formed to operate a street railway in Yonkers, either by electricity or horse power, or both, the road to be five miles long. W. D. Baldwin S. T. Hubbard, Jr., J. C. Shotts, J. J. Devitt, T. H. Silkman, J. S. Fitch, L. M. Saunders, W. E. Hodgman, Yonkers, and R. B. Kelly, New York, are interested.

Special Correspondence.

Western Notes.

Branch Office of The Electrical World, 936 Monadnack Building, Chicago, July 14, 1894.

JOHN R. MARKLE, whose name is familiar to our readers, has been placed in charge of all the Western business of the Electric Storage Battery Company, of Philadelphia. Mr. Markle makes his headquarters at 1409 Manhattan Building, where he can be found almost any time buried in work.

THE WEST CHICAGO STREET RAILWAY COMPANY will soon let contracts for the erection of an immense electric power house at the intersection of California avenue and Roscoe Boulevard to furnish the motive power for the trolley lines of the company, to be operated in connection with the Milwaukee avenue cable system. The structure will be one story and a half high, and will cover 100 x 125 feet of ground.

THE AMERICAN ELECTRICAL WORKS, of Providence, is one of the large houses of the country which has come to the conclusion that Western business justifies a branch office in this city. They now have handsome quarters at

241 Madison street, where Mr. T. E. Donohoe is in charge. Mr. Donohoe is busy getting things in shape and is ready to receive friends of the company.

THE JENNEY ELECTRIC MOTOR COMPANY, of Indianapolis, Ind., has been reorganized on a very strong financial basis. It is now arranging for the erection of new works in the city of Indianapolis to cover many acres of ground, as its business has recently grown to huge proportions. Western Manager Goode reports business excellent considering the times, and the new fortunes of the company will be welcomed by its thousands of friends.

THE ABENDROTH & ROOT MANUFACTURING COMPANY has opened an office at 1422 Monadnock Building, and placed it in charge of Mr. George K. Hooper. This firm is well-known in the West by reason of its famous water tube boiler; but it appreciates that to have a manager on the ground will materially assist in closing many of the large orders that will soon be placed in this vicinity. Mr. Hooper will find many words of praise for his boiler throughout the West.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, whose offices on the fifth floor of the Monadnock are the busiest in the building, seem to be overwhelmed with business in the shape of new exchanges and orders for private line telephones. Manager Stitch and President Keelyn are always at their desks, while Treasurer Kennedy is busy with the books. Its factory on the West Side is overcrowded with work, and it seems to be on the increase. One of its latest successes was the securing of a large order from the Metropolitan "L" road, which has ordered an equipment for every station on its line.

Canadian Notes.

Ottawa, July 14.

TORONTO.—The street railway revenue shows an increase in spite of the hard times. The total earnings for June were $88,335, of which the city's share was $7,066. In June, 1892, the city's share was $6,729, and in June, 1893, $6,039.

WINNIPEG.—The Judicial Committee of the Imperial Privy Council have given judgment in the case of the Winnipeg Street Railway Company vs. the Winnipeg Electric Street Railway Company and the city of Winnipeg, affirming the judgments appealed against.

MONTREAL.—The Railway Committee has passed the contested bill respecting the Montreal Park & Island Railway Company, and made the capital stock $1,000,000, against the protest of Mr. Williams, the promoter of the bonus for the road, who has $125,000 of stock given him for his services.

OTTAWA, ONT.—At a meeting of the newly appointed directors of the Electric Street Railway, J. W. McRae was elected president, and Mr. G. P. Brophy vice-president. After the Governor-General assents to the bill for the amalgamation of the two roads, the shareholders of each will be called to elect a new board of directors and reorganize.

MONTREAL.—Electrical railway construction is making wonderfully rapid headway on the island of Montreal. Last fall the Montreal and Island Park Co. built a road to the Back River, a distance of six miles, and now the same system is being extended round the mountain to Cote des Neiges, the intention being to further extend the railway to Notre Dame de Grace, and connect with the Montreal Street Railway at Cote St. Antoine.

OTTAWA, ONT.—The agreement between the corporation and the amalgamated lighting companies for the lighting of the city for ten years after the expiration of the present contract has been signed by Messrs. G. P. Brophy, president; D. R. Street, secretary, and W. Y. Soper, director, of the Chaudiere Electric Lighting Company; Messrs. E. H. Bronson, president, and G. B. Pattee, director, of the Standard Electric Lighting Company, and City Clerk Henderson.

English Notes.

(From our own Correspondent.)

London, July 4, 1894.

ELECTRIC LIGHTING AND THE FACTORY ACTS.—At the Westminster Police Court recently there was a batch of prosecutions against the owners of several small workshops for permitting women to work on their premises after the authorized time, and not providing sufficient cubic space. One of the defendants made a somewhat ingenious pleading, which was to the effect that as he had adopted the electric light, which did not vitiate the atmosphere, he considered that overtime on his premises could not be injurious to the workers from the respiratory point of view. This ingenious pleading was not, however, of any avail.

HORSE TRACTION AS AN AID TO ELECTRIC TRACTION.—At a recent meeting of the Association of Municipal Engineers a paper was read by Mr. R. Hammond on the subject of electric traction, and it must be confessed that although for the most part it contained nothing but generalties, there was at least one startling idea. Mr. Hammond advocated the combination of the electric lighting with the electric traction business. He pointed out that for a few hours every day the heavy traction load and the heavy lighting load would coincide. He made several suggestions as to how this difficulty might be overcome, and ended up by pointing that the best way out of the difficulty was to temporarily horse the cars.

INDUSTRIAL EDUCATION AND TRADE-UNIONISM.—The Technical Education Board recently appointed by the London County Council has instituted a series of conferences between the members of the board and representatives of the industries of the Metropolis, with the laudable object of discovering exactly what it is the British workman requires in the way of technical or industrial training. There was a general consensus of opinion amongst the delegates of the engineering and allied trades that the law should oblige employers to afford their apprentices time during the day to attend classes for systematic instruction in the principles of their craft; that these classes should be in touch with the trade; that the instructors should be practical workmen; that no one but those actually engaged in the trade should be allowed to attend these classes. The demand that the technical classes should be in touch with the trade generally took the form that they should be controlled by the trades-unions, and the demand that no one but those actually engaged in the trade should be allowed to attend the classes went so far as to exclude experienced gas fitters and house carpenters from adding to their earning powers by obtaining that modicum of electrical knowledge necessary to make them efficient wiremen. Up to the present the average electrical wireman may, for aught we know, be a very efficient electrician, but he certainly is uncommonly clumsy in getting about the house, and in that respect an electrically competent gas fitter or carpenter would probably make a much better workman than the so-called electric light wireman.

News of the Week.

Telegraph and Telephone.

NEWBERNE, N. C.—Address P. H. Pelletier regarding a new telephone exchange to be established.

SALISBURY, N.C.—A franchise for constructing a telephone system has been granted to J. Allen Brown and others.

DANBURY, CONN.—Hoyt & Russell, manufacturers of telephones, are reported to have dissolved partnership.

AMERICUS, GA.—The Bell Telephone Company will construct a line to Albany, Ga. Jeff. D. Peacock is manager of the exchange.

SHELBYVILLE, IND.—Franchises have been granted to the Mutual Telephone Company, in which George C. Platt and D. C. Yowell are interested.

CHESTERTOWN, N. Y.—The Chestertown Telephone Company has built a line to the Palisades, a new hotel on the shores of Brant Lake, kept by Smith Barton. This company is about to extend its line to Warrensburgh. All the hotels at Fieand's Lake are connected with Chestertown.

PHILADELPHIA, PA.—A number of business men visited the Bullitt Building and inspected the workings of the automatic switchboard of the Mutual Automatic Telephone Company, which by ordinance of Councils has been given authority to cover the entire city by the new system.

Electric Light and Power.

WILLIAMSVILLE, ILL.—The citizens are agitating the question of an electric lighting plant.

DALLAS, TEX.—Judge T. F. Nash may be written to in regard to an electric wiring contract.

LOS ANGELES, CAL.—Franchises have been granted to Chas. Walton to put in an electric plant.

ELBERTON, GA.—Address D. A. Matthews regarding the establishment of an electric power plant.

NORWOOD, PA.—Address G. C. Skelton regarding electric lighting contract to be given out August 1.

FRONT ROYAL, VA.—The Council is considering the matter of establishing a municipal lighting plant.

LAFAYETTE, COL.—A franchise has been granted to J. S. Spencer to furnish light, heat and power to the town.

CAPE GIRARDEAU, MO.—Franchises have been granted to R. W. and T. W. Gannon to put in an electric light plant.

ESTHERVILLE, IA.—N. B. Egbert, city clerk, can be addressed regarding construction of an electric light plant.

PAWNEE CITY, NEB.—A movement is on foot to establish an electric light plant in connection with the water works.

MARSHALL, MINN.—The vote to bond Marshall for $25,000 for electric light and water bonds was carried by 73 majority.

KALAMAZOO, MICH.—Address Chauncey Strong, city clerk, regarding the construction of an electric light plant for the city.

CLARKSBURG, W. VA.—Address D. P. Morgan, president Traders' Company, concerning the installation of an electric light plant.

GONZALES, TEX.—F. R. Starr, Jr., may be addressed regarding a 500-light dynamo to be put in by the Goliac Water Power Company.

WELLS, MINN.—The village has called a special election for July 24 to vote on the question of issuing $20,000 electric light and water bonds.

BALTIMORE, MD.—The Viaduct Manufacturing Company is about to erect a new electrical plant to replace the one recently burned at Relay, Md.

SHAWANO, WIS.—An ordinance is before the Council for establishing an electric plant. Final action will be taken July 30. A. C. Weber is city clerk.

YATES CITY, ILL.—A franchise has been granted to the Elmwood Electric Light Company to establish an electric plant. T. J. Knightlinger is city clerk.

KEY WEST, FLA.—The Key West Gas and Electric Light Company has increased its capital stock from $75,000 to $250,000 for the purpose of enlarging its plant.

CARROLL, ILL.—An ordinance has been passed granting ten years franchise to C. P. Woodworth to operate an electric light plant. Aaron Smith is city clerk.

BALTIMORE, MD.—During the Summer a new 12 h. p. electric motor will be put in the Baltimore Colored Manual Training School, on Fremont avenue, near Lombard street.

WASHINGTON, D. C.—Horace S. Cummings, acting for a syndicate, is reported as having purchased a $14,000 tract of land on which a large electric plant will be erected.

CROWLEY, LA.—The Council has secured O. H. Landreth to prepare plans and specifications for an electric light and water plant. The contract will be let as soon as the specifications are ready.

NEW YORK CITY, N. Y.—The United Electric Light and Power Company, 108 Fulton street, will erect a one-story brick electric light station at No. 407 to 419 East Twenty-eight street, to cost $80,000.

ALBERT LEA, MINN.—The electric light and power house, C. G. Edwards manager and principal owner, has been burned. The dynamos were entirely destroyed. The loss is $8,000, with no insurance.

SHELBYVILLE, KY.—The Shelbyville Water and Light Company is in the market for engines, dynamos, apparatus, lamps, poles, wiring, etc., of the electric light plant to be constructed by that company.

WAKEFIELD, MASS.—A meeting will be held July 16 for the purpose of providing for an issue of bonds to the amount of $144,080, to be used for the purchase of the Citizens' Gas and Electric Company's plant.

HENDERSON, MINN.—Sealed proposals for an electric light plant for the city of Henderson, Sibley County, will be received until August 1, 1894. Plans and specifications on file with the city clerk J. J. Mohre.

NAPOLEON, O.—Sealed proposals will be received until July 24 for electrical

apparatus, one 60-light dynamo, and one 1,500 incandescent light dynamo, including a first-class electric light plant. J. Koller is city clerk.

The Electric Railway.

SAN FRANCISCO, CAL.—Address J. A. Russell, city clerk, regarding street railway franchises.

SKOWHEGAN, ME.—The town has voted $10,000 in aid of an electric road from Norridgewock to this place.

DELAWARE, O. A franchise has been granted to the Delaware Electric Railway Company to extend its lines.

ROME, N. Y.—The Rome City Street Railway Company is about to change its system to electric motive power.

MONTGOMERY, ALA.—The Montgomery Street Railway Company has been granted a franchise to extend its lines.

RUTHERFORD, N. J. It is proposed to construct a trolley line from this place to connect with the main line to Jersey City.

PROVIDENCE, R. I.—The Union Railroad Company proposes to extend its line from Exchange to Smith's Hill, by way of Francis street.

LEWISTON, ME.—The Lewiston & Auburn Horse Railroad Company has decided to adopt electricity as a motor power on its lines at once.

COLUMBUS, GA.—The North Highlands Railroad Company, operating an electric railway, has been granted a franchise to extend its lines.

PHILADELPHIA, PA.—Charles McCaul is receiving bids for the new power house of the Electric Traction Company, which is to be a large structure.

LEWISTON, N. Y.—The Lewiston & Youngstown Electric Railroad will be reorganized and will build an electric railroad from Lewiston to Youngstown.

DRACUT, MASS.—The Lowell, Lawrence & Haverhill Street Railroad Company has received a permit to construct an electric road within the city limits.

CUMBERLAND HILL, R. I.—The Woodsocket Electric Power and Machine Company has asked for permission to construct an electric road from Manville to Cumberland.

WASHINGTON, D. C.—The Alexandria & Mount Vernon Electric Railway has permission to construct an electric road through Arlington reservation to this place.

WASHINGTON, D. C.—The Eckington & Soldiers' Home Railroad has been granted permission to put down an underground electric system, invented by Malone Wheless.

BALTIMORE, MD.—The Baltimore, Conton & Point Breeze Railway Company contemplates constructing an electric road from Battle Monument to the eastern city limits.

GUTHRIE, OKLA.—Address Charles Fitzgerald in regard to a street railway, for which he has been granted a franchise, but for which the equipment has not yet been purchased.

RUTHERFORDTON, N. J.—Jonah White writes: "It is now an assured fact that an electric railway will be built from Rutherfordton to Chimney Rock, a distance of seventeen miles.

HARTFORD, CONN.—An electric railway between this city and Rockville before the end of the year is assured, and Manchester will be connected with Hartford by an electric line by October 1.

ST. AUGUSTINE, FLA.—Address Charles Sperry, superintendent St. Augustine Railroad and Steamboat Company, 12 West Thirty-first street, New York, concerning an electric railway to be constructed.

SAND LAKE, N. Y.—It is now an assured fact that an electric road is to be built between Sand Lake and Troy. J. K. Averill has been appointed a committee to interview the stockholders in regard to the stock, etc.

KNOXVILLE, TENN.—It is reported that Messrs. Eperandieu and Cramer, representing the Niagara Power and Development Company, are endeavoring to form a company to build a five-mile electric road to Spring Place.

BLOOMFIELD, N. J.—A petition from the North Jersey Street Railroad Company for a franchise for an electric line from the Newark passenger line to the Monticello line was referred to the Committee on Law and Franchises.

RUTLAND, VT.—A meeting of the stockholders of the new street railway company, to be known as the City Electric Company, was held, and following directors elected: E. A. Morse, E. M. Woodruff, J. E. Creed and others.

LANCASTER, PA.—The Pennsylvania Traction Company, operating the entire electric railway system of Lancaster County, has decided to extend its lines through the county. The contract for the work will be awarded next week.

KEY WEST, FLA.—John J. Philbrick, of Key West, is completing arrangements in New York City for the transfer of the street railway property to the Key West Electric Street Railway Company. Horse power will be superseded by electricity.

CRISFIELD, MD.—The Somerset Electric Light and Railway Company was chartered by the last Legislature with Thomas S. Hodson, of 6 East Lexington Street, Baltimore, as president. About two and one-half miles of road will be built.

NORTHAMPTON, MASS.—Business has so rapidly increased on the electric railroad that the company is now to petition the aldermen for the privilege of double tracking the road on Main street. The line will be built this year if request is granted.

BRISTOL, CONN.—The directors of the Bristol & Plainfield Tramway Company and the borough committee have reached an agreement in regard to the construction of the proposed line. The incorporators are N. E. Pierce, Treadway & Muzzy, of Bristol, and others.

BALTIMORE, MD.—The Maryland Central Railroad Company is reported to be seriously considering the operation of its line by electricity. In this connection it is stated that the Baltimore & Ohio Railroad trains will be run through the belt tunnels by powerful electric motors.

BRADFORD, PA.—The city councils passed the ordinance granting the Bradford Electric Street Railway Company exclusive right and privilege to construct and operate a street car line from the American House, in East Bradford, through the Third and Fourth Wards, etc.

Miscellaneous Notes.

PROFESSOR HELMHOLTZ, as we go to press, is reported by cable to be dying.

THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK has issued the report of its eleventh annual meeting, held at Rochester, September 19, 1893. Only one paper was read at his meeting, "The Return Circuit of Electric Railways," by T. J. McTighe, but this with its discussion is a valuable contribution to the subject.

MR. JOHN B. M'CORMICK, the well-known Holyoke, Mass., manufacturer of turbines, has written a pamphlet entitled "Reasoning from Cause to Effect," and containing his opinions on the economic and industrial situation. Mr. McCormick is a firm believer in free trade, and this pamphlet is a remarkable contribution to the subject.

KILLED BY LIGHTNING. Two men were recently killed at the Norfolk Navy Yard by lightning under peculiar circumstances. A number of men had sought shelter beneath the steel cruiser Raleigh, which lay in dry-dock there, when suddenly two of the men fell dead and others were knocked senseless by an electric shock, which was not felt by the officers on the deck. All the compasses were affected, and the vessel was magnetized.

FULL OF ELECTRICITY.—A young man employed at the Edison Lamp Works, Harrison, N. J., recently received a severe shock from an electric current, rendering him unconscious, in which state he remained, notwithstanding the efforts of physicians to restore him. It was finally decided by the doctors and an aunt of the young man that his body was full of electricity, which if removed would permit him to recover. An insulated wire was therefore grounded to a water pipe and a wet sponge at the other end applied to the body of the young man, when, to the delight of the aunt and the medical attendants, he regained consciousness, and a new principle in electro-therapeutics was established. What the effect of sponging alone would have been we are unfortunately left in the dark.

Trade and Industrial Notes.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has received an order from the United Electric Light, Heat and Power Co., of New York City, for an iron roof, with anti-condensation corrugated iron roof covering, for a switch board building.

THE UNITED STATES HEADLIGHT COMPANY, Utica, N. Y., has made arrangements with I. A. Williams & Co., Utica, N. Y., and Chicago, Ill., to act as one of its agents for the sale of its locomotive, electric, cable and motor car and other headlights.

THE JONES MANUFACTURING COMPANY, 1820 and 1822 Mechanic street, Norwalk, Conn., manufacturer of typewriter supplies of every description, claims that its factory is one of the most complete in the United States, and that every month shows a large increase in business, notwithstanding the hard times.

ARMATURE WINDING.—We have received a communication from the Chelsey Manufacturing Company, of Hoboken, N. J., claiming that the system of spiral winding, or angular advance of section, described in these columns as devised by S. W. Rushmore, was invented and patented by Mr. George Hoare, of Brooklyn; that it has also been used by the Excelsior Electric Company, and that it is only applicable to armatures wound with a single turn of wire.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 572-578 First Avenue, New York City, has received a very flattering letter from Hilton, Hughes & Co., expressing the greatest satisfaction with the 500 incandescent arc lamps installed in their large establishment. Hilton, Hughes & Co. state that the lamps are not only sightly in appearance, but the light is absolutely steady and agreeable, and particularly well adapted to show off goods like theirs; in fact, that the lighting is beyond criticism.

"MODERN TURRET LATHE PRACTICE" is the title of a pamphlet issued by the Gisholt Machine Company, Madison, Wis. The pamphlet gives illustrations taken from actual practice of some of the uses to which the company's turret lathes are put, and it is the intention to issue it monthly in the belief that the range of application of the turret lathe is so large, and that many of the most successful operations are so different from accepted practice, that the publication will be welcomed by superintendents, foremen and proprietors of manufacturing machine shops.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Indiana, has issued a 38-page general catalogue of its various electrical porcelain manufactures and the Laclede and Hercules carbon batteries. Unlike other porcelain and carbon manufacturers, this firm gives undivided attention to the making of electrical goods, and therefore naturally pays particular attention to the electrical properties of the material. The porcelain, we learn from the catalogue, is burnt with natural gas, the temperature being 4,000 degrees Fahr., thus producing an excellent insulating glaze, and the carbon used in the batteries is also made from natural gas.

THE ELECTRIC APPLIANCE COMPANY, Chicago, appreciating the fact tha users of colored and frosted incandescent lamps have undoubtedly frequently suffered considerable inconvenience from inability to get their orders for fancy goods filled promptly from stock, has perfected plans for frosting and coloring lamps of all kinds in Chicago and established a coloring room for doing this work, and can now furnish colored and frosted lamps promptly on receipt of orders. By the use of improved coloring compounds and methods of treating results have been secured in colored and frosted lamps, fully equalling those obtained from genuine colored and frosted glass. Customers will undoubtedly show their appreciation of prompt delivery on these goods.

THE ALTOONA MANUFACTURING COMPANY, Altoona, Pa., reports the following orders received during June: One 280-h. p. engine, for the Akron Street Railway Company, of Akron, O., to be direct-coupled to a 250-h. p. generator built by the Walker Manufacturing Company, of Cleveland O.; one 150-h. p. inclosed type self-oiling engine for the Watson Mining and Manufacturing Company, of Monongahela City, Pa., for an electric mining and haulage plant; one 65-h. p. inclosed type, self-oiling engine for the Lyceum Theatre, Philadelphia; one 175-h. p. standard centre-crank engine for the Freeport Electric Com-

pany., Freeport, Ill.; one 65-h. p. inclosed type, self-oiling engine for Knight Bros., Fayette, Ia. There is considerably more inquiry and with a settlement of the railroad strike it is believed that a substantial improvement in business will result.

THE WENSTROM APPARATUS, for which Henry B. Oakman, 136 Liberty Street, New York, is the general eastern agent, is meeting with exceptional success, and the following sales for the past month are reported: Two 30 k.w. generators for the St. James Hotel, N.Y.; one 35 h.p. motor to the American Grocery Company, N. Y.; one 50 and one 30 kw. to the Empire Hotel, N. Y.; one 30 kw. to the Stevens Apartment House, N. Y.; one 10 kw. to the Adams House, N. Y.; one 30 kw. to the Lake View Brewing Company, Buffalo, N. Y.; two 50 kw. to the Gould Coupler Company, Depew, N. Y.; one 25 kw. to Earle's Hotel, Richfield Springs, N. Y., and one 15 kw. to the Co-operative Brewing Company, Buffalo, making a total of over 7,000 lights capacity.

THE "ACME" PORTABLE VOLTMETER.—Queen & Co., of Philadelphia, have for months past held back from the market a new type of portable voltmeter for both alternating and direct current circuits, in order to give it a thorough time test. They are now satisfied that the instrument is thoroughly adapted to laboratory as also station measurements, and are preparing to manufacture it in sufficient quantities to meet the large demand which seems assured so soon as the merits of the voltmeter become known. It operates on the "hot-wire" principle and is absolutely free from hysteresis error, thus being correct for alternating circuits of any frequency. It is dead beat without a mechanical brake—a most important feature—and is the most compact reliable instrument of its class made. Twenty different ranges cover potentials from two volts to three thousand, and by means of a special interchangeable adapter which fits the Edison, Thomson-Houston or Westinghouse systems, measurements can be made very rapidly. The "Acme" Voltmeter received the highest World's Fair award because "It possesses high sensibility over the entire scale, and its zero is not affected by changes of temperature. The instrument is unusually compact and portable." The instrument was fully described in The Electrical World of March 3, 1894.

P. AND B. BUILDING AND INSULATING PAPER.—The validity of United States Patent No. 378,520, under which this paper is manufactured, has been established in case of the Standard Paint Company vs. Henry J. Bird and James L. Reynolds, where after an exhaustive litigation extending over four and a quarter years, and after consideration of a printed record of upward of 1,000 pages, the Circuit Court of the United States for the District of New Jersey, on July 5, 1894, made and entered a decree adjudging that the patent was valid and had been infringed by the defendants and directing an injunction against the defendants and an accounting. The opinion of the court, written by George M. Dallas, Circuit Judge, holds that the patent covers any paper coated with a solid residuum obtained from the distillation of petroleum, and that the manufacture and sale of any substantially similar paper is an infringement of the patent. The coating mentioned, and which, as established by the evidence in the case and by decree of the court, was first used by this company, and protected by the United States patent referred to, makes an odorless, water, acid and alkali proof and thoroughly insulating paper, as is well known. The court holds that papers possessing these essential characteristics, which were new up to the time of their introduction under the name of P. & B., made by others, are a violation and infringement of the complainant's rights.

EDWARD F. AUSTIN, contracting engineer and manufacturers' agent, 95 Fifth Avenue, Pittsburgh, Pa., has just completed the installation of a 50 h. p. M. A. Green improved automatic engine to operate a 500-light Westinghouse dynamo in the Christ M. E. Church of that city. The plant possesses more than usual interest on account of its being one of the first to be installed in a church for lighting purposes. The following sales of M. A. Green engines in that vicinity are also reported: One 80 h. p. to the New Castle Car Manufacturing Company, of New Castle, Pa.; one 50 to 180 h. p. to Jones & Lockwood, Pittsburgh, for the operation of electric cranes, with which their mills have been equipped; two 60 h. p. for the McIntosh-Verner Building, Pittsburgh; one 150 h. p. to the Watson Mining and Manufacturing Company, of Monongahela City, Pa., and one 12x14 to the Lorch-Eble Machine Company, of Pittsburgh.

Business Notices.

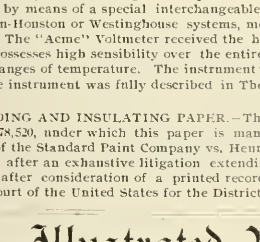
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 10, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

REISSUE 11,428. ELECTRIC SIGNALLING APPARATUS; J. P. Coleman, Swissvale, Pa. Application filed December 5, 1893. In an apparatus for connecting a signal with its primary actuating mechanism, the combination, with the signal and its connecting rod, of a pivoted lever which forms one of the mechanical connections between the signal and the actuating mechanism, the lever being movable on its pivot into and out of connection with the signal connecting rod, and an electromagnet which acts on the lever to hold it in connection with the signal connecting rod.

522,580. DYNAMO ELECTRIC MACHINE; L. Bell, Lynn, Mass. Application filed September 19, 1892. An alternating current motor having the adjacent faces of its armature and field magnet poles provided with coil chambers,



No. 522,580—DYNAMO ELECTRIC MACHINE.

teeth and channels of such shape and so arranged that the reluctance of the magnetic path through them is uniform at all positions of the moving parts. (See illustration.)

522,581. CONTROLLER FOR; ELECTRIC MOTORS; J. B. Flood, Lynn, Mass. Application filed December 18, 1393. A switch adapted to start the motors in one direction and regulate their movement from rest to highest speeds, and in the reverse direction to start and cause them to operate at lowest speed.

522,597. ELECTRIC SWITCH; J. Hutchinson, New York, N. Y. Application filed June 14, 1893. This comprises a tube, an insulating saddle, stationary contacts carried thereby, a spindle passing through the saddle, and a movable contact-bearing part carried by the spindle.

522,621. COMBINED HANGER AND AUTOMATIC SWITCH FOR TROLLEY WIRES; R. Scheibauer, Paterson, N. J. Application filed July 15, 1893. This comprises a body of insulating material, two levers attached thereto, a hanger from which the insulating body is suspended, and two sets of contact jaws on the hanger.

522,632. CIRCUIT CLOSING DEVICE; P. J. Walsh, Jr., Philadelphia, Pa. Application filed May 3, 1894. This comprises a supporting case plate, a tongue pivoted thereto, a spring acting on the block, and terminals, the point of contact of the terminals being so disposed that in making contact they will simply abut without sliding friction.

522,655. CONDUIT RAILWAY TROLLEY; J. L. Creveling, Auburn, N. Y. Application filed April 5, 1894. This consists of a depending plate in combination with trolleys supported on either side thereof by a pair of pivoted arms.

522,664. ELECTRIC DISTRIBUTION BOX; O. D. & M. A. Kleinsteuber, Milwaukee, Wis. Application filed April 5, 1894. This comprises a box, an insulating base therein, and a series of pairs of contact sections having arms extended through the insulating base to be electrically connected with strands of cables.

522,670. DANGER SIGNAL FOR RAILWAY CROSSINGS; M. W. Parrish, Detroit, Mich. Application filed October 30, 1893. This comprises a signal, electrical actuating mechanism therefor, and contact devices operated by a passing train to set the signal in operation.

522,674. ELECTRIC METER; G. A. Scheeffer, Peoria, Ill. Application filed April 12, 1894. The combination of a stationary multipolar magnet, provided with three polar or magnetic surfaces and a metallic cylindrical rotating armature magnetized thereby.

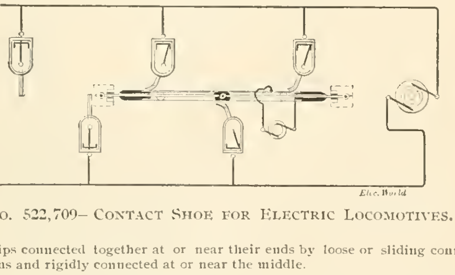
522,680. ELECTRIC ARC LAMP; M. S. Okun, New York, N. Y. Application filed September 1, 1892. The combination of a carbon carrying rod, a lever, a sliding rod carried by the lever to support the first rod, and a counterbalance to equalize the weight of the lever.

522,690. ELECTRIC LAMP HOLDER; M. P. Meyer, Rochester, N. Y. Application filed February 27, 1894. The combination of an insulated holder, a lamp guard constructed of wire, and a shade on the holder.

522,707. TELEPHONY; F. R. Colvin, New York, N. Y. Application filed May 22, 1894. This comprises a telephone in permanently closed relation to the line terminals, and a call receiving instrument in shunt relation to the telephone the shunt including contacts electrically bridged by a contact piece carried by the telephone and removable therewith to open the shunt when the telephone is removed.

522,709. CONTACT SHOE FOR ELECTRIC LOCOMOTIVES; J. J. Green, Boonton, N. J. Application filed July 5, 1893. This consists of separate end pieces, side strips of flexible material secured thereto, and a flexible or yielding central bar to which the insulated end piece are loosely attached. (See illustration.)

522,710. CONTACT BAR FOR ELECTRIC LOCOMOTIVES; J. J. Green, Boonton, N. J. Application filed October 9, 1893. This consists of flexible side



No. 522,709—CONTACT SHOE FOR ELECTRIC LOCOMOTIVES.

strips connected together at or near their ends by loose or sliding connections and rigidly connected at or near the middle.

522,711. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; J. J. Green, Boonton, N. J. Application filed October 9, 1893. A shoe for electric railways having plates or strips with side contact faces arranged in or about the same vertical plane, one above the other.

522,718. ELECTRIC HEATER; H. W. Leonard, New York, N. Y. Application filed March 22, 1893. A heater having a thinly insulated conductor imbedded in and completely surrounded by a closely applied mass of metal.

522,724. ELECTRIC SYNCHRONIZER FOR CLOCKS; L. Von Orth, Berlin, Germany. Application filed May 6, 1892. The combination of a pendulum, a

verge rod provided with a pivoted lever in separable connection with the pendulum, an armature lever, an electromagnet, and a cam adapted to control the motion of the lever.

522,727. ELECTRIC LAMP LIGHTER; J. C. Chambers, Detroit, Mich. Application filed February 10, 1894. This comprises a rigid support, a framework pivoted thereto, a swinging lamp, a contact device carried by the framework, and a contact device carried by the lamp.

522,733. ELECTRIC DOOR OPENER; H. F. Keil, New York, N. Y. Application filed January 30, 1894. The combination of magnets, an insulating plate, an armature, a locking dog shaft having one end conically bored and the other tapered and held in place, and a lock latch having a spring.

522,735. ELECTRIC ARC LAMP; P. Kirkegaard, Brooklyn, N. Y. Application filed September 28, 1893. A carbon holder consisting of a U-shaped yoke pivotally connected with the end of the carbon rod, in combination with two jaws pivoted respectively to the arms of the yoke. (See illustration.)

522,745. INSULATING COMPOSITION; J. L. Truslow, Summit, N. J. Application filed July 27, 1893. A composite mass for insulating purposes, consisting of ground cork and infusorial earth, and a binder of rosin.

522,757. DEVICE FOR PREVENTING RAILROAD COLLISIONS; C. Holtmann and N. Schmidt, Pittsburg, Pa. Application filed November 14, 1893. This comprises a track battery for each "block" and an instrument in connection with the air brake which will set the brakes when any two trains enter the same block at the same time.

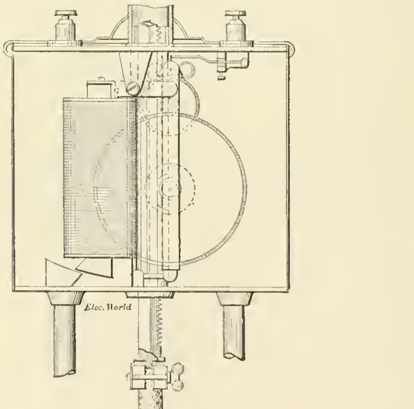
522,790. ELECTRIC ARC LAMP; E. F. Gwynn, Delaware, Ohio. Application filed April 28, 1893. This comprises a carbon rod, gearing for feeding the same mounted on a movable lever controlled by a magnet in the main circuit, and a friction clutch arranged in the gearing, and a stationary device adapted by the movement of the lever to operate the friction clutch and thus disengage the carbon rod from the gearing to permit the carbon rod to feed independent of the gearing.

522,820. MEANS FOR REGULATING ALTERNATING CURRENT MOTORS; E. M. Bentley, Boston, Mass. Application filed Apil 17, 1893. The method of changing the relative phase periods of primary and secondary alternating currents which consists of passing such primary current through the primary of a transformer and shifting the points of connection of the secondary and the line relatively to the polarity of the primary. (See illustration.)

522,834. ELECTRIC LOCOMOTIVE; E. Hopkinson, Manchester, England. Application filed July 21, 1891. The combination with the driving axle of the motor having its armature built upon an axle, and its magnets and polar pieces suspended beneath the axle from journals thereon.

522,835. ELECTRIC CRANE; E. Hopkinson, Manchester, England. Application filed July 21, 1888. The combination with the motor shaft serving as an axle, traveling wheels and lifting barrel, of clutches by which the axle can be connected to or disconnected from the traveling wheels and be connected to or disconnected from the lifting barrel.

522,836. GALVANIC BATTERY; L. F. Johnson, Poughkeepsie, N. Y. Application filed April 7, 1894. An electrolyte composed of sulphuric acid, water



No. 522,735—Electric Arc Lamp.

having chromate of calcium dissolved therein, and nitric acid, the said components being unmixed and arranged in the cell in the order named.

522,837. CURRENT SEPARATOR; L. F. Johnson, Poughkeepsie, N. Y. Application filed April 7, 1894. This comprises connections for the main circuit, a common connection for one side of the local circuit to one side of the main circuit, independent connections for the other side of the local circuits, and means for interposing resistance between the connections for the main circuit and at the same time connecting in one or more of the local circuits, whereby the local current receives the shunt from said resistance.

522,841. ELECTRIC BELT; W. E. J. Lawlor, Portland, Ore. Application filed September 14, 1893. This comprises a copper plate bent into a link and provided with a slot and tongue, a slide fitted to the plate, a perforated zinc plate and a porous septum.

522,844. TOLLEY EAR; C. A. Lieb, New York, N. Y. Application filed April 12, 1894. A trolley ear having a sheet metal portion with an upwardly extending fin or fold and a cast metal bolt portion secured to the fin or fold.

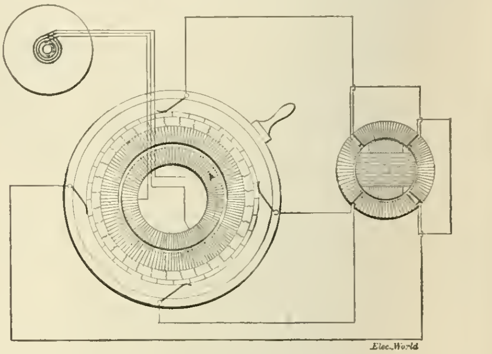
522,845. TROLLEY WHEEL; C. A. Lieb, New York, N. Y. Application filed April 12, 1894. A trolley wheel having a central core of copper or bronze and provided with steel flanges having stiffened edges.

522,851. MOTOR SAFETY DEVICE; A. W. K. Peirce, Plymouth, Mass. Application filed October 29, 1892. The combination of a dynamo with a shunt around its field circuit comprising a non-inductive resistance, a switch controlling the main circuit of the machine, and an auxiliary switch in the shunt circuit controlled by the main switch.

522,859. INSULATED ARMATURE COIL; J. H. Shugg, Boston, Mass. Application filed April 21, 1894. An electric coil the conductors of which are bound together and insulated by two layers of tape between which is interposed an oiled fabric.

522,865. CURRENT INTERRUPTER FOR HIGH POTENTIAL CIRCUITS; E. Thomson, Swampscott, Mass. Application filed February 6, 1893. The combination with two separable terminals of a spring actuated drum connected with one of said terminals and an electromagnet adapted to disconnect said terminals.

522,892. TELAUTOGRAPH; E. Gray, Highland Park, Ill. Application filed March 8, 1893. The method of transmitting and recording a character by the movements of a transmitting pen and a receiving pen by transmuting the movements of a transmitting pen into electric pulsations, sending to line



No. 522,820—Means for Regulating Alternating Current Motors.

in the reversing circuit a current of changed strength upon reversal of the transmitting pen in one or two crosswise directions of motion, and a current of changed polarity upon reversal in the other of the two crosswise directions of motion of the transmitting pen, thereby reversing the movement of the receiving pen in said two directions respectively.

522,893. TELAUTOGRAPH; E. Gray, Highland Park, Ill. Application filed February 27, 1894. The combination in a telautograph of a power mechanism, a torsional spring, and means for maintaining constant the tension of the spring, a reversing mechanism and a receiving pen.

522,894. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; C. I. Greer, Washington, D. C. Application filed April 16, 1894. This comprises a slot cover, composed of a series of plates of rigid material having central-depending webs, which are pivotally linked together.

522,896. HANGER FOR ELECTRIC LAMPS; H. C. Henley, St. Louis, Mo. Application filed July 27, 1893. This comprises an externally threaded pipe, an internally threaded shell having a chamber into which the pipe discharges moisture, and an annular insulator fitting upon the pipe and within the shell out of reach of the moisture discharged from the pipe.

522,915. TROLLEY POLE; A. S. McBean, Montreal, Canada. Application filed April 10, 1894. A trolley wheel support composed of a metal section rigidly secured to the trolley pole, an adjusting platform and a frame piece, the latter carrying the trolley wheel or runner, with a swiveling connection between the adjusting platform and the frame piece.

522,919. ELECTRIC CIGAR LIGHTER; C. F. Reiff and H. Munk, Fremont, O. Application filed January 25, 1894. This comprises a wick tube, a contact point carried thereby, an over-balance tube hinged to the wick tube, a plug in the upper end thereof, an arm secured thereto and carrying a spring contact, and electric conductors connected with the tube and arm.

522,925. OPERATOR'S TELEPHONE CIRCUIT; T. C. Wales, Jr. Application filed December 2, 1893. This comprises a transmitting telephone in the local circuit, an induction coil having a single primary winding, included in the local circuit, and two secondary windings in circuit serially with the main line conductors, together with a branch extending from a point between them to earth, and a receiving telephone in a branch of the local circuit, shunting the primary windings.

522,934. ELECTRIC CIGAR LIGHTER; J. J. Eberhard and C. G. Schimkatt, Fremont, O. Application filed Sept. 25, 1893. This comprises a cross bar, depending hangers, a lamp pivoted to the lower end thereof, carrying a contact device adapted in the swinging of the lamp to engage with a contact device on the supporting framework of the lighter.

522,948. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. Application filed October 3, 1892. This comprises a vibrating lever, a coil supported on one arm thereof, a fixed coil in inductive proximity to the movable coil, a means of equilibrating the movable coil and a spring opposing the vibration of the lever.

522,949. WATT METER; E. Weston, Newark, N. J. Application filed April 26, 1893. The combination of a fixed coil, a movable coil in the field of the fixed coil, a spiral spring opposing the movement of the movable coil, fixed resistance, a pole hanger and circuit connections.

522,950. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. Application filed February 21, 1894. The combination with a wall or support, of an electrical measuring instrument movable about a pivot on the support, and means for adjusting the instrument so that its face may be disposed at various angles to the support.

The Electrical World.

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CONTENTS.

NEW ELECTRICAL INVENTIONS.

Whether by a mere coincidence or as indicating a revival of the inventive faculty in the higher ranks of electricians, our patent record this week contains an unusual number of patents coupled with well-known names, most of which recall the first years of electrical development. Among these names we find Thomson, Houston, Jenney, Scribner, R. M. Hunter, E. H. Johnson, J. F. Kelley, Cuttriss, Silvey, Haskins, Kester, A. Langstaff Johnston, Doane and several others well known in electrical circles. We give an extended account in our columns of several of the inventions, and others of interest that might have been added are omitted from lack of space. One of the most interesting of the various devices is the thermostat of Mr. Chas. Cuttriss, which seems to be the first time the remarkably simple principle upon which it is based has been applied to this purpose.

DEATH BY ELECTRICITY.

In this issue the Digest gives an account of some experiments on the effect of alternating electric currents on animal organisms, described in a paper read before a recent medical congress at Rome, Italy, and which corroborate the views of D'Arsonval, referred to recently in these columns. The current used was an alternating one, and it was found that animals subjected to from 1,500 to 2,000 volts were not easily killed, and that death resulted mostly from asphyxia caused by the sudden stoppage of respiration. Frequently breathing started again spontaneously and the animal recovered completely. In no case was there any physiological change noted, though in a few there were mechanical lesions, in themselves cause for death. This further confirmation of D'Arsonval's formula, "A man shocked by electricity should be treated as if drowned," renders it still more important that the electrician should make himself acquainted with the proper means of resuscitation from the effects of electric shock.

STORAGE BATTERIES FOR ELECTRIC POWER STATIONS.

We recently commented upon the use of storage batteries in the power station of a street railway at Zurich, Switzerland, and the Digest this week gives some further particulars in regard to the same plant. The saving in this case, if we can accept the figures given as strictly correct, is very marked, being no less than 2.2 lbs. of coal per h. p. hour, which amounts to more than a ton a day, or sufficient to pay for the storage battery plant in four years. As the adoption of the battery system, however, actually reduced the first cost of the plant on account of replacing more expensive machinery, the saving is a direct one, and in a comparison should be credited with the interest charges on the reduction in first cost and with the maintenance charges of the machinery displaced. It will be noted that the voltage of the discharge side is kept constant by automatically cutting in and out regulating cells, which are apparently charged from a separate dynamo. This does not seem to be actually necessary, though the economy of operation in keeping the line voltage constant is somewhat increased thereby. The results achieved with this plant are very encouraging, and strongly confirm the conclusions stated in the excellent paper on storage batteries for power stations read at last year's annual convention of the American Street Railway Association by Mr. C. O. Mailloux. We trust that it will not take so long for the matter to be taken up on this side of the Atlantic as did the use of storage batteries in central station work.

ELECTRICAL DUPES.

Barnum's saying that "Americans love to be humbugged" certainly seems to apply in electrical matters, though in this respect the distinction made in regard to nationality is questionable, for

Europeans appear to bite as eagerly at an electrical bait as Americans. We must confess to having little sympathy with most of these victims, for as a rule they seem to have become the prey of their own vanity thinking that their crude habits of thought are sufficient to form a judgment of greater weight than that of scientific authorities. One of the most barefaced electrical swindles in existence has been reaping a harvest from this class for seven or eight years, and although it has been so repeatedly exposed that few or any of those who invest in its promises can be ignorant of the manner in which it is regarded by all electricians, yet the returns seem to be as flourishing to-day as at the beginning. The system to which we refer claims among other things that by means of its apparatus 20 horse power can be put into a boat and "100 horse power—yes, 200 horse power" delivered to the propeller shaft. It is interesting to note the arguments used, which have been remarkably successful in their results. There seem to be only two of these, one to dispose of critics and the other to cover up the improbability of the claims. The former one is that the system would so entirely annihilate all of the established electrical companies that these have entered into a conspiracy among themselves and with the electrical press to depreciate the invention and persecute the inventor, which accounts for the ridicule of the former and the defamation of the latter. In answer to criticisms as to the improbability of the invention, it is pointed out that all great inventions have been similarly regarded; that the incandescent lamp, the telephone and everything that was new to the theoretical fellows were called impossibilities, but nevertheless netted great fortunes to the shrewd investors who were not imposed upon by book twaddle. It is a curious commentary upon the weakness of human nature that these arguments, in the face of the fact that the apparatus has been before the public for years without demonstrating its claims, should have the potency they have, and apparently always will have. The dupes who are imposed upon by such specious means are to be classed in the same category with of the hayseed customer of the "green goods" man, and, from electrical people at least, are likely to receive as little sympathy.

CONSULTING VS. CONTRACTING ENGINEERS.

Our esteemed London contemporary, *The Electrical Review*, has again returned to the subject of contracting engineers acting as professional consultants, against which practice it is emphatically opposed, and good reasons are offered for the ground which it takes. The contractor, it is stated, must, by the very nature of his business, be necessarily biased in his judgment, and with a human tendency to recommend what will best further his firm's present or future interest. For the purchaser to get the most perfect plant and that most suitable to the conditions under which it will have to work, the employment always of a competent professional mechanical and electrical engineer—one with unbiased, independent and wide views and in no way connected with any manufacturer or contractor—is urged, thereby enabling full advantage to be taken of the wide field of electrical science and its continuous development. That this should be the course of the purchaser seems obvious, but in this country it is nevertheless seldom the one adopted. Until quite recently the engineers of electrical selling companies were also the engineers of the purchaser, and one result has been that, owing to competition and therefore the necessity of cutting down a bid to the last penny, the plants thus designed have as a rule been far from what they would have been if laid out by disinterested engineers inclined to take other matters into consideration than the lowest possible first cost. It is very much to the credit of the various manufacturing companies that the result of this system has not been much worse than it has proved, for the tendency would seem to be almost irresistible to sacrifice everything to bring the figures of a bid to the lowest possible notch. It has often been remarked that in the United States electrical plants are far inferior to European ones in engineering design and efficiency, and it is natural that this should follow from the system above referred to. Although, of course, the cost of such plants has been much less relatively than in Europe, yet the lack of other important elements in most cases has overbalanced this, for in laying out and installing machinery, low first cost is usually a bad criterion to follow exclusively. Another disadvantage is that such a system discourages development, for it leads to the adoption of so-called standards in order to cheapen manufacture, with the consequence that frequently new principles cannot be adopted at once without an expense that would often not offer an equivalent advantage in the judgment of a purchaser lacking disinterested professional advice. This is probably the reason why in central station machinery we were some years behind European practice, and why the adoption of improvements like direct-connected machinery and others has been by jumps rather than by a gradual process of amelioration. While, therefore, it seems to be the part of wisdom for a purchaser to employ an engineer as a professional adviser, it does not follow that the latter should be deaf to suggestions from the engineers of contractors, who, in this country at least, are often the most competent men in the profession, and with exceptional opportunities to keep thoroughly posted in all details. The role of the former should rather be confined to that of referee, and though it might sometimes be advisable for him to draw up a skeleton plan, most of the details could with advantage be left open until the suggestions of contractors had been carefully weighed. This, we believe, is the course usually followed in preparing the specifications for electrical machinery, but the opposite rule appears to obtain in contracting for the wiring of large office buildings, though this is the case where most advantage might be gained from meeting the contractor half way. To draw up satisfactory wiring specifications for a large building from architects' plans is not a simple matter to one not actually engaged in installing such work, and in almost every case better results would probably be obtained by asking for bids on contractors' own plans, based on general requirements as to drop, materials and workmanship. Owing to competition, it would be to the interest of the latter to be guided by economical considerations throughout, and the saving in this respect would perhaps justify the offer of prizes, as in architects' competitions, to defray the cost of preparation of the specifications not accepted but nevertheless found to be meritorious.

The Measurement of Polyphased Currents.

To the Editor of The Electrical World:

SIR:—In a recent article, published in your journal in the issue of June 23, on "The Measurement of Polyphased Currents," by A. D. Lunt, I see my name cited (p. 832) in relation to a certain formula. From the way in which Mr. Lunt presents the matter, it might be supposed by the readers that he is the author of the more general formula,

$$P = \Sigma \frac{1}{T} \int_{o}^{T} i\,(v - v_o)\,dt, \qquad \text{(p. 805)}$$

applicable to all known systems of polpyhased currents, for he follows it with this remark (p. 832): "Hitherto the above results have been reached, either in a less natural way, or on an assumption based upon the form of the circuit in which the energy is utilized." Mr. Lunt also seems to present as his own the method of multiple wattmeters (mechanical combination of wattmeters).

In reality, this method, the above general formula, and all the deductions have, on the contrary, been brought out in my paper in *La Lumière Electrique*, January 21, 1893, page 139 (Sur la Mesure des Courants Polyphasés), from which Mr. Lunt claims to have borrowed only one formula of small interest. My article even ends with words which are almost identical with those of Mr. Lunt: "The foregoing demonstration is more general than those given heretofore; it does not make any assumption on the form of the circuit of utilization." I beg you to kindly call the attention of the readers of your esteemed journal to this fact, in order to avoid a misunderstanding.

This entire question is, besides, so extraordinarily simple that it is difficult to understand the protracted search that has been made for complicated formulas and demonstrations. I would not have thought of writing this letter, referring to a matter of so little importance, if Mr. J. D. E. Duncan, after a complicated and less general demonstration, had not recently formulated this surprising opinion: "An analytical proof for a perfect general case is too complicated to be followed easily" (E. W., June 9, 1894, p. 763); but it seemed to me that this statement should not remain unanswered.

A. BLONDEL.

Ecole Nationale des Ponts et Chaussées, Paris, France.

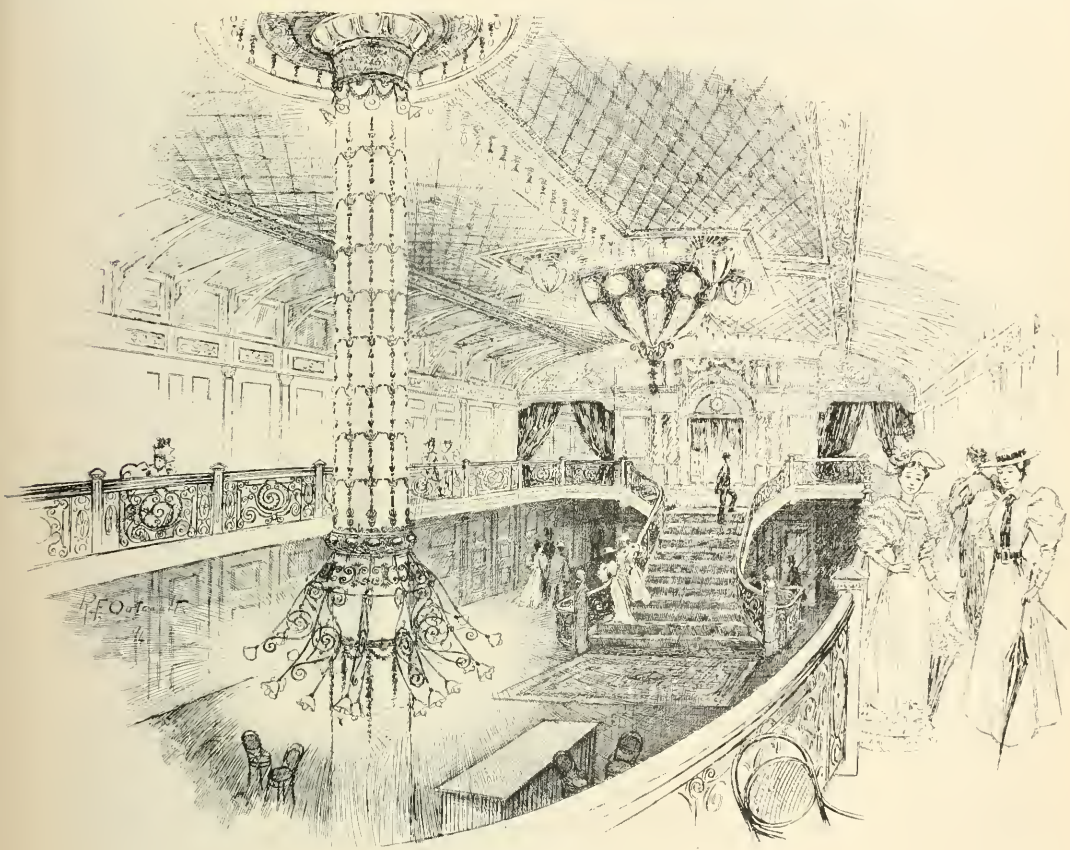
Electricity on the Sound Steamer Priscilla.

Of all the imposing sights which the traveler over the great bridge suspended in midair between New York and Brooklyn can behold, none is more singularly striking than the procession of steamers which passes beneath that airy arch a few minutes after half-past five each evening, carrying hundreds of busy people from New York and her sister cities to different points on the eastern coast, thence to be disseminated into the bustling New England States. The deep boom of a steam whistle sounds upon the air from a source hidden by the massive buildings of the southern end of the city, and in a few short seconds the huge nose of a huger steamer is pushed into the field of vision as it rounds the point of the Battery, and a broadside view is momentarily had of an immense leviathan, whose storied sides glisten white in the western sunlight against the sombre green of Governor's Island and the purple uplands of Staten Island as a background, as it moves across and slowly turns in a wide sweep into the East River. Another whistle, and the coughing tugs and lumbering ferry craft of antique and uncouth pattern take to flight.

The tall structure advances, throwing from her sharp bow two curling narrow white ribbons of water which pass down either side and are swallowed up in the heavy foam, churned up by the feathering paddles of the side wheels and passing in converging lines into the distance.

Her advance is now swift, although she is traveling at modulated speed, and the spectator on the bridge soon distinguishes the individuals in the crowded mass of living freight upon her decks, outside, like himself, to witness and enjoy the passing show. Still nearer, and as he looks down, he sees beneath him through the bewildering network of the bridge structure a long, gray ellipse, whose even surface is broken only by the two black cavernous apertures of the smoke stacks, and much fluttering bunting, which passes rapidly, and strikes out into relief as tier upon tier of her galleried and decorated stern, set in a foaming, eddying mass of seething water, rise and move forward from beneath the suspended roadway. The smaller craft on each side of her rock madly in the waves which the huge mass propelled through the water creates, but she recks little of them as she passes grandly on, a marine object of singular beauty, more stately than any other floating thing on sea or ocean, until she disappears from sight behind the extreme easterly point of the island.

Such is the Priscilla as she moves at the head of the evening procession. She is the grandest and largest of her class, and her appearance is the signal for a cessation of pedestrian travel on the bridge. Man, woman and child stop to watch her progress between the great gateway of gray masonry and iron which spans the opening to the Sound.



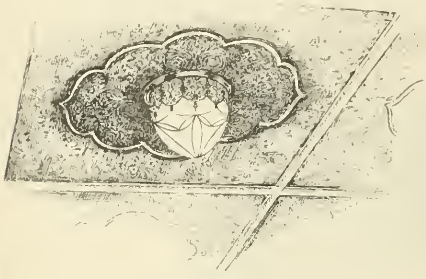
Grand Staircase from Main Saloon.

The Priscilla is the latest addition to the Fall River Line fleet, and embodies within herself all the latest improvements, architectural, mechanical and electrical, and exemplifies the high pitch to which the ship building art has been brought in this country. Following the lines of structure of purely American design, she differs radically in appearance from any steam or sailing craft to be found in foreign waters, and while she affords a pleasing spectacle to American eyes, she is something more than a surprise to those from other lands who have just come hither. Seen from the deck of a ferry boat, she looms up like a many-storied hotel, and her huge yet graceful proportions dwarf into insignificance everything near her afloat!

Her dimensions are as follows: Length over all, 440 feet 6 inches; length on water line, 423 feet 6 inches; breadth over guards, 93 feet; breadth of hull, 52 feet 6 inches; depth of hull, 20 feet 6 inches; tonnage, 5,398.

She is made just narrow enough to admit her to the widest dry dock in New York. Mild steel enters into the construction of this boat in every part. Her double hull is of steel, and in framework and structure it plays the leading role. In the saloons and cabins, hidden by the architectural and artistic effects, steel trusses spring from the decks at the bases of the walls on either side, and develop into arches upon which the different superstructures rest. Braces and knees of steel are placed everywhere where they can add to the strength and resistance, and all this metallic skeleton work renders the Priscilla one of the staunchest of marine edifices.

As the passenger crosses the gang plank laid from the wharf,



A Panel in the Dining Room Ceiling.

which is no exception to all the wharves which disgrace the magnificent water front of the metropolis, he steps upon the quarter-deck, which is the entrance hall to this most sumptuous of peripatetic hotels. This is of generous proportions and stretches aft of the engine room from side to side of the vessel. The floor is laid with a purple gray Venetian conglomerate with an elaborate border. The walls are of a delicate cream color, the salient curves and foliates being emphasized by judicious gilding. As this is the first room entered, it may as well be noted that the entire interior decoration of the saloons, with one exception, which will be noted hereafter, is in delicate half-tones, creams and pearl grays deepening into light browns.

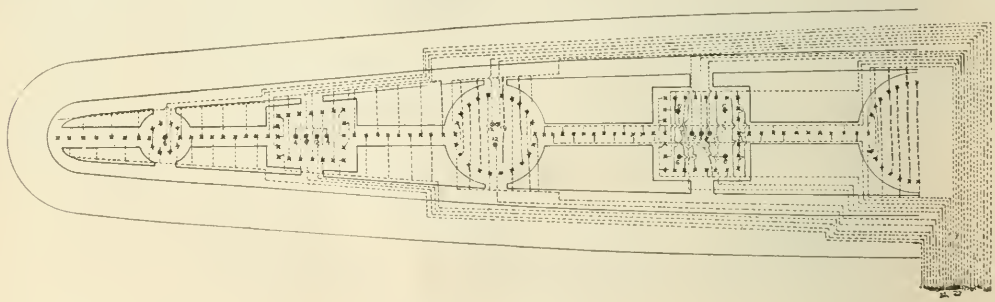
Eight stanchions or round pillars of steel spring from the quarter-deck and support part of the saloon deck above. Each stanchion, colored deep mahogany red, has a capital of light, which is made up of a polished ornamented brass tulip, the petals of which are of opalescent glass, in the interior of which, like the stamens of the flower, are twelve incandescent lamps. Around the hall is a dado and above this is a succession of twelve panels, of which two are curved, all especially designed for the Priscilla. They are supposed to be emblematic of the differents arts and sciences which contributed to the construction and purposes of the boat. Commerce, Machinery, Architecture, Electricity, Music, Dancing, etc., etc., and, as befits the case, one is devoted to Priscilla herself turning her spinning wheel in her cottage of Colonial days. The frieze is highly ornate and runs entirely around the hall. On each side of the hall is a room, one the purser's office and the other the barber's shop, lighted by a four-light chandelier and four two-light clusters.

Between the quarter-deck and the dining room, which is also on the main deck, is a vestibule, to which entrance is gained through swinging glass doors. From this the passenger passes into the dining-room. This is a spacious and lofty room running aft, provided with broad windows opening out upon the water upon each side. Between the windows are large mirrors, framed in ornamental woodwork. The scheme of decoration is sombreness and richness. The carpets are dark, the highly decorative woodwork is of mahogany, and the chair and window seat coverings are of dark olive-green leather. The scheme of lighting is bold and successful. Over each window is a box with stained glass sides, upon which is worked a beautiful design, each of which contains ten 16 c. p. lamps. Similar glass receptacles are placed over the doors and mirrors at each end of the room. The ceiling is finished in beams and straps of mahogany, and panelled. Each panel has a medallion in the centre, and each alternate panel an electric "pendant." This pendant is an elliptical bowl of opalescent glass, held in a rope net of brass and containing two 16-c. p. lamps. There are six rows of these from side to side of the cabin. On each side of the sideboard at the after end are two niches, in front of each of which hangs a basket pendant of opalescent glass containing an incandescent lamp.

Still further aft, and on each side, are two private dining-rooms, each lighted by five elliptical bowls forming quincunx, a large one in the centre, and four others, one at each corner in the panel immediately over the table. Aft of these are the ladies' cabins.

The lights in the dining-room are controlled from two panel switchboards set under one sideboard on each side. These panel boards will be described when we speak of the electrical equipment. Altogether there are 305 lights in this room.

Returning and passing through the dining-room and quarter-deck, the passenger ascends the staircase, with wrought iron and mahogany balustrade, into the main saloon, which runs the entire length of the vessel. The stairway is lighted by three bull's eyes in the arch. This saloon is the drawing-room of the vessel. It is decorated and furnished in most pleasing style, and yet all the ceiling and mural decorations are of nothing more than moulded papier-maché, which has been found more durable than wood and better capable of lending itself to artistic effect. It is all colored in half-tones of creams and light browns, picked out with gilt. The carpets and upholstery are of a warm tint, admirably contrasting with the delicate colors on the walls. A wide elliptical opening aft of the engine room causes the ceiling of the dome to be in part that of the saloon. The lighting of the saloon other than from the dome is effected by three eight-light electroliers set between the stanchions, and a series of two-light brackets set all around between the state-room doors. The mast passes up through the saloon and carries a highly ornamental fixture at the height of the gallery deck. In this fixture, from a central band, branches bend down and out and carry at their terminals frosted incandescent lamps set in opalescent globes. In the forward saloon the mast has no fixture.



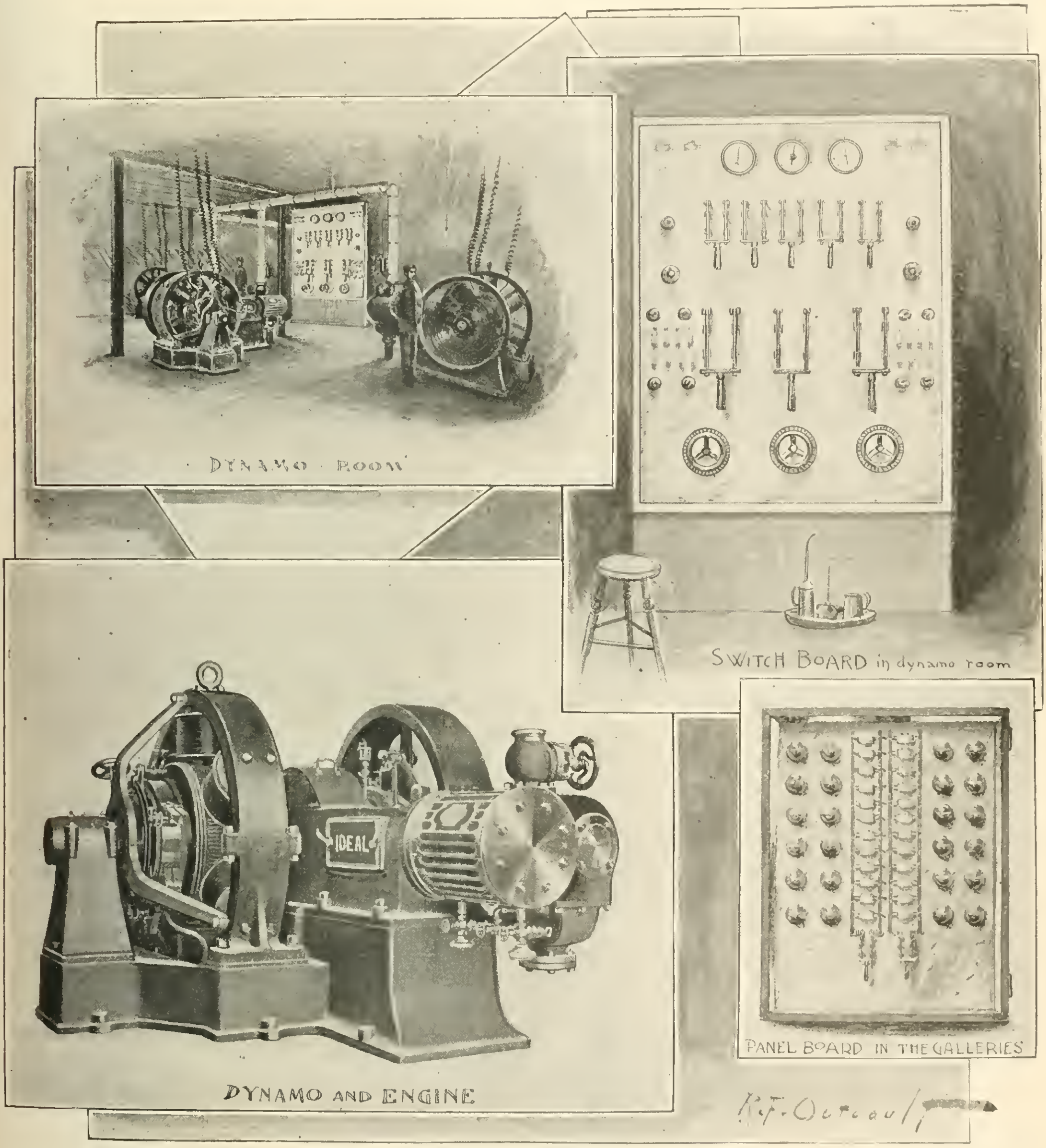
Circuits of Gallery Deck.

At the forward end of the main saloon is the grand staircase leading to the gallery deck. The bulkhead at the head of this is the chief ornamental feature of the whole boat. It is an imitation *en grande* of an old-time *cheminée*, with twisted columns on either side of a large central mirror, a floral device lying within the convolutes. Over the mirror is a gilded clock, set in a semicircular mosaic, in which the only example of bad taste on the whole boat is to be found. This mosaic is a mixture of blues, reds and greens in glaring tonality, which jars on the nerves and quarrels with all the other delicate half-tones which prevail. A four-light bracket with upright lights is set on each side of this mirror. The passages are lighted by means of pretty sprays, each carrying three lights, and the toilet rooms are indicated by red globes with the usual legend. Staterooms lighted by one-light brackets open out on either side of the saloon and gallery.

The scheme of lighting of the dome is both beautiful, intricate

and effective. The principal feature is the central fixture, which takes the form of an inverted dome of brass work of complex pattern, in which are framed panels of opalescent glass. This is dependant from the ceiling half-way between the bulkhead of the gallery staircase and the mast. Within this inverted dome are 48 lights. It is set in the ceiling in a quadrangular medallion, at each

The lighting of the gallery saloon is carried out on a similar plan to that of the main saloon. It of course benefits from the lighting of the fixtures just mentioned. In addition it has one twelve-light electrolier in the forward saloon, and a row of twelve incandescent lamps around the mast. Forward of the gallery saloon are the cabins of the president, captain and the principal officers, lighted



DIRECT CONNECTED DYNAMOS, MAIN AND PANEL SWITCHBOARDS.

corner of which is a much smaller inverted opalescent dome. Further aft is another large inverted dome of somewhat smaller proportions, attended by two lesser satellites, one forward and one aft of it, and still further aft another single inverted dome. Starting at the bulkhead is an inverted ridge of frosted lights in the ceiling, the sockets being set in metal tulips. This breaks into a quadrangular bower around the large central fixture, a circle around the mast, a narrow quadrangle around the second dome fixture, and a circle around the third. In the forward saloon two eight-light electroliers are the main features.

by electroliers and brackets. Upon the dome deck are constructed the cabins of the lesser dignitaries and the pilot house.

The lighting of the decks and all the other parts of the vessel in which the public is not supposed to penetrate, such as the crew and waiters' quarters, kitchens, boiler rooms, etc.—in other words, the working quarters—is effected by means of lanterns, some hung as pendants, others arranged horizontally against the ceilings, all protected by cages and wherever moisture can reach them with watertight globes and sockets. Those on the decks which could be confused with the ship's signal lights are obscured in front by

curved pieces of sheet iron, which effectually prevent the light from streaming forward. In addition to the lights just mentioned, there are the side lights, masthead, bow and stern lights.

The distribution of the lighting is as follows: Dome deck, 9 circuits, 55 lights; gallery deck, 68 circuits, 596 lights; saloon deck, 44 circuits, 360 lights; main deck, 78 circuits, 748 lights; lower deck, 12 circuits, 92 lights; hold, 18 circuits, 136 lights; total, 229 circuits, 1,987 lights.

From these figures some idea may be gained of the intricate construction work which had to be effected.

Turning now to the mechanical equipment of the Priscilla, the engine room is its most important feature. This is a spacious room, rising clear into the dome, and from its floor the engineer looks down upon the two pairs of long steel piston rods, and two pairs of similar rods running from the knuckle joints to the huge cranks. The engine is double inclined compound, with two 51-inch high-pressure cylinders forward, and two 95-inch low-pressure cylinders aft of the crank shaft. The piston stroke is 11 feet. These were built by the W. and A. Fletcher Co., of Hoboken, the contractors for the vessel complete. This room is lighted by four five-light electroliers and numerous bulkhead fixtures, 129 lights in all.

Iron stairways lead down to the level of the cylinders, and in this part of the engine room the temperature becomes torrid, and the serviceable little Lundell fan motor is called into requisition. The condensers occupy each side of the room, as do two circulating pumps; the bilge pump is placed on the port side.

The ten boilers in the hold are Scotch return tubular, each having three corrugated furnaces, giving a total grate surface of 850 square feet. The boilers are 14½ feet long and 14 feet in diameter, are constructed for a working pressure of 150 pounds per square inch, and have an indicated horse power of 8,500. They are arranged for natural or forced draught.

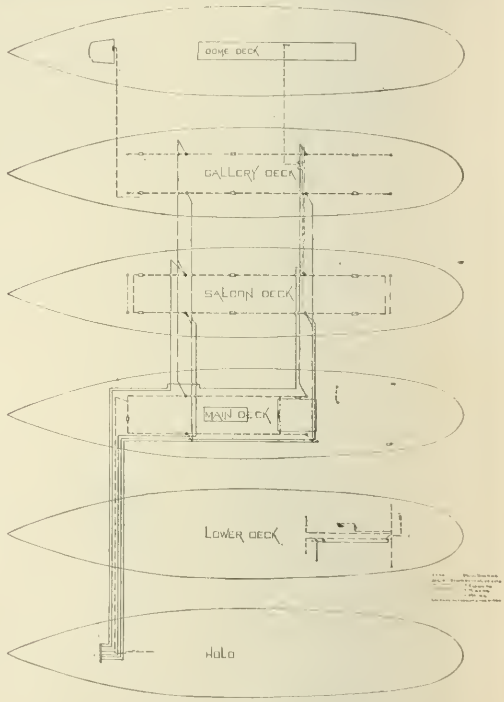
The electrical equipment of the Priscilla is a masterpiece of electrical engineering skill. It forms the most extensive isolated marine electric light plant ever installed, and consists primarily of three direct driven units located forward of the boiler room in a space in which it would be difficult to swing the traditional feline. Standing with his back to the switchboard, the spectator sees three engines arranged radially with the cylinders almost touching him, one directly in front and one on either side. These are 11x12 Harrisburg Ideal engines, with outboard bearings, from the Harrisburg Machine Works, a type which has become very widely known in connection with direct connected work. The automatic self-oiling arrangement is entirely enclosed, and the motion of the piston is so smooth as hardly to occasion a tremor. The engines are both condensing and non-condensing, and are bolted to yellow pine frames fastened to the inner hull.

Upon the bed plate of each engine is arranged a 50 kw. six pole 275 revolution General Electric multipolar generator having a capacity of 400 amperes at 125 volts. These are of a type also widely known as highly efficient machines. They have ironclad armatures, that is, the copper bar armature windings are embedded in the armature body, and the movement of the brushes is simultaneously effected by means of a hand wheel. Rising from each dynamo are spiralled cables, which pass along the ceiling to the switchboard. This is of marble, framed in mahogany. At the base of the board are the three hand wheels which operate the contact arms passing over the clips of the field regulators standing on the floor behind it. Above these are the three dynamo switches, flanked by the two voltmeter switches, and over these are the five main switches. A Weston illuminated dial voltmeter stands on each side of the board, and three 450-ampere ammeters are arranged in a line along the upper portion. The vessel is wired throughout on the two-wire system.

On each side and back of the switchboard is a 10 h. p. Sturtevant blower, each directly driven by its own vertical engine. The dynamo room is lighted by four three-light electroliers and several lamps fixed in the ceiling.

From the switchboard run five feeders to the main deck. At four points of the vessel risers mount to the upper decks. These are connected to the circulating mains, one of which is on each deck, by means of four centre of distribution safety fuse holders to each circulating main. At six points in each circulating main, whence the smaller wires branch off to the state-rooms, saloons and dining-rooms, are set marble panel cutout boards. These panel boards are of special design, and each has its own peculiar form to fit into the position where it could most conveniently be placed. They are fitted with knife blade switches, which bring the current to two pair of strips of flat copper, between which are set fuse carriers of porcelain. Connection is made behind the board with a snapswitch for almost every circuit. These Hutchinson-Herrick panel boards are handsome and ingenious devices, doing away with a cumbersome system of cutouts. The fuse carrier is a porcelain box, from each side of which projects a small flat copper bar, the inside ends of which have set screws for holding the fuse. The lid is held in place by a pin, and when the carrier is charged it is simply pressed into the clips fastened to the upright strips which run the length of the board. There are 25 of these panel boards. Those on the saloon and gallery decks are set in the transoms of the doors of the passages, those in the dining-room under two of the sideboards, that in the engine room facing the engines, and the others in places where it is most convenient. The two largest are that in the engine room with 24 circuits, and that on the gallery deck controlling the lighting of the dome, which has also 24 circuits.

All the wiring appliances used are those which have been devised by the General Electric Company to meet Government requirements. All the junction boxes, switches, cutout boxes used in the deck and exposed wiring are absolutely watertight, and are all finished like the lanterns, in black. In all parts of the vessel where the wiring might be exposed to moisture, the wire is lead covered, and all the



PLAN OF FEEDERS AND MAINS.

wire larger than No. 6 B. & S. is stranded. Forty-five miles of wire in all is used in the vessel, and in accordance with American marine practice wires are used for the return. The wire used is a special white core marine wire manufactured by the General Electric Company and conforming to Government specifications. The lights are so divided that ten in each circuit is the limit. A series of charts showing the location of each circuit, each light and each appliance, is hung in the engine room, so that the electrician's liability to error may be almost entirely prevented.

The entire electrical equipment was furnished and installed by the General Electric Company, while every one of the lighting fixtures, from the most artistic to the most simple, was designed and made by the General Fixture Company, of New York.

Exception should be made of the 364 electric call bells, 610 automatic fire alarms, and the watchmen's clocks, which were put in by the American Fire Alarm Company, of Boston.

The Priscilla cost a million and a half, is licensed to carry 1,500 passengers and 35 car loads of freight. She makes the trip between New York and Fall River in ten hours, and burns 50 tons of coal a night. She has a crew of 206 men, and to effect a complete circuit of the vessel one and one-eighth miles would have to be covered. She is commanded by Capt. Abram G. Simmons.

Polyphase Transformations.

BY G. M. WARNER.

There have been lately several methods of transforming multiphase currents into single phase currents advanced, purporting to tax equally the several phases of the system, and, perhaps, a few figures on the subject may not be amiss.

Let us investigate a quarter phase system: Assuming our E. M. Fs. and currents to vary according to a curve of sines, we may represent them by $a \sin x$ and $b \sin x$ in one phase and $a \sin (x + 90)$ and $b \sin (x + 90)$ in the other, when working on non-inductive loads.

The power of these circuits would be $(a \sin x)(b \sin x) = a\,b \sin^2 x$ and $(a \sin \{x + 90\})(b \sin \{x + 90\}) = a\,b \cos^2 x$, adding gives $a\,b(\sin^2 x + \cos^2 x) = a\,b =$ a constant; that is, the total flow of energy in the system is a constant.

If the currents in each phase lag behind their respective E. M. Fs. 45°, we would have

$$(a \sin x)(b \sin \{x + 45\}) = (a \sin x)\frac{b}{\sqrt{2}}(\sin x + \cos x$$

$$= \frac{a\,b}{\sqrt{2}} \sin^2 x + \frac{a\,b}{\sqrt{2}} \sin x \cos x$$

and

$$(a \sin \{x + 90\}) \times (b \sin [\{x + 90\} + 45])$$

$$= (a \cos x)\frac{b}{\sqrt{2}}(\sin (x + 90) + \cos (x + 90)$$

$$= \frac{a\,b}{\sqrt{2}}(\cos^2 x - \frac{a\,b}{\sqrt{2}} \sin x \cos x,$$

adding, we get $\frac{a\,b}{\sqrt{2}}(\sin^2 x + \cos^2 x) = \frac{a\,b}{\sqrt{2}}$ and still a constant.

This is true of any multiphase system of circuits equal in every respect.

Now we will look at the single phase system with E.M.F. $c \sin x$ and current, in same phase, $d \sin x$; the power would be $(c \sin x)(d \sin x) = cd \sin^2 x$, or no longer a constant, but rather varies from zero to twice its average twice in one cycle.

The same is true if the current lags behind its E. M. F.

From this, it would seem that it would be impossible to transform from one system to the other by static transformers, for in the primary we would have a constant flow of energy, and in the secondary a variable flow, hence the transformer would have to store up energy at times.

Any storage of energy by magnetic means has as yet been very inefficient, and the only recourse has been to a heavy rotating part.

Taking up the method of winding the primary with two circuits, one in each phase, and taking off only one secondary, obtaining thus a single phase current.

While I grant that if we are feeding a non-inductive load both of the phases will be equally loaded, I do not agree that the effect on the generator will be the same.

In a winding, as above, I believe the currents in the two phases are in the same phase—that is, in one circuit the current lags 45° behind the E. M. F., while in the other the current is in advance of its E. M. F. by 45°, and in proof we have

$$[a \sin (x + 45)]\,[b \sin x] = \left(\frac{a}{\sqrt{2}} \sin x + \frac{a}{\sqrt{2}} \cos x\right) b \sin x$$

$$= \frac{a\,b \sin^2 x}{\sqrt{2}} + \frac{a\,b}{\sqrt{2}} \sin x \cos x$$

and

$$[a \sin (x - 45)]\,[b \sin x] = \frac{a\,b \sin^2 x}{\sqrt{2}} - \frac{a\,b}{\sqrt{2}} \sin x \cos x,$$

adding we have

$\sqrt{2}\,a\,b \sin^2 x =$ a constant times $\sin^2 x$ or the same as a single phase circuit.

It will be noticed that the E. M. Fs. $a \sin (x + 45)$, and $a \sin (x - 45)$ are 90° apart in phase, giving the quarter phase distribution, and the current $b \sin x$ lags 45° behind one, and precedes the other by 45°.

This angular difference being the same in both circuits, the power will also be the same; but this should be noticed, one has a powerfully "inductive" load, while the other is feeding an equal "capacity" load, tending to unbalance the armature reaction in the dynamo

Supposing in addition each phase is loaded with an equal load which is inductive, causing a lag of 45°, then in circuit No. 1 we have two equal currents, each differing from the E. M. F. by 45° lag, while in the other we have two currents, one lagging 45°, while the other is in advance 45°.

The effect of this would be that in one circuit we would have a current equal to 2, while in the other a current equal to $\sqrt{2}$, which, though equally loading the two phases, would not necessarily equally effect the regulation of the dynamo.

Invention of the Telegraph.

In a communication under this head, which appeared in The Electrical World of July 7, an unfortunate typographical error occurred which changed the author's meaning. In the second paragraph of the second column, instead of reading "Alfred Vail sought in court to obtain the justice which he knew was due him," it should have read "Alfred Vail sought no court to obtain the justice which he knew was due him." In the first line of the following paragraph the word "evening" should be substituted by "morning."

Amateur Motor Building.—II.

BY G. E. DUNTON.

The armature and fields of the motor whose mechanical construction was described in the previous issue will be wound for a compound high-speed machine of 55 volts, to be used on an incandescent circuit, and without a rheostat. This machine may be used for either a higher or a lower potential or to run on a battery current by merely changing the gauge and number of turns of wire on both field and armature. As the potential grows higher more turns of finer wire are needed, there being, of course, certain limitations which enter as to speed and regulation. As the potential decreases the volume of current may be safely increased, fewer turns of coarser wire being used and the field wound in series with the armature, using a wire four times larger than the armature wire. The field core must be carefully taped between the sections of lagging, winding the tape, on up through the inside and around down the outside the length of the core. The edge of each layer should

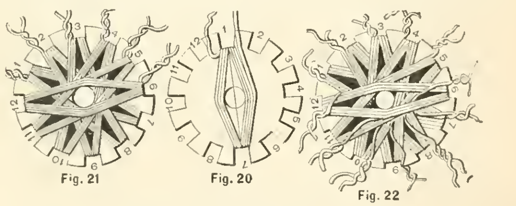


Fig. 21 Fig. 20 Fig. 22

DETAILS OF ARMATURE WINDING.

overlap the one before it about half its width; this will give really two thicknesses of tape, which will be sufficient. Thin Kerite or Okonite tape is the best. In winding the field coils, a wooden shuttle one foot long, shaped so that it will pass through between the pole pieces easily, will be needed. Make this of three strips cut from a cigar box, rounding off the ends and sides and making the capacity for holding wire as great as possible. (See Fig. 19.)

The theory and practice of electrical construction requires so much exercise of judgment that it makes it impossible for the beginner to attain the result he desires by theoretical methods. In designing a motor to run on a circuit in multiple arc without a rheostat, it will be found almost impossible for the amateur to figure out the exact gauge and amount of wire to use and attain the result desired and expected. Taking the model as a guide to follow and using the amounts and gauges the same results should be attained. The compound wound, so-called "self regulating" motor has two distinct and separate coils wound upon its fields; one, called the series coil, has few turns of coarse or low resistance wire carrying the whole current and is in series with the armature; the other, called the shunt, consists of many turns of fine wire of high resistance, and is connected across the circuit in parallel, or in multiple, with the armature, carrying a small portion of the whole current.

Contrary to usual custom, the field will first be wound and the series coils put inside next to the core. About one-half pound of No. 22 B. & S. double cotton covered, and one pound of No. 28 copper wire will be needed; this will allow something extra in case of accident. If a compound known to electricians as insulac can be procured, purchase one pint; if not, get some good clear orange shellac and a small, flat, soft brush. Carefully wind the No. 22 wire on the shuttle ready for use. Paint the end of the wire for about one inch with asphaltum varnish or some quick black drier. Begin from the front or commutator end of the top side of the

core to wind, leaving about eight inches of wire which twist loosely around the long bearing stud on the left side of the core; pass the shuttle down through between the pole pieces from the front to the back, around the end and up on the outside, laying the wire down close to the top side of the wide wooden lagging on the left hand side of the core. Pass the shuttle down between the pole-pieces again, laying the second strand snug beside the first one, and continue around and around, winding slowly and laying the strands snug and even until the narrow or top lagging is reached; the last strand should lay right in snug to this, go around on the inside of

The Armature.

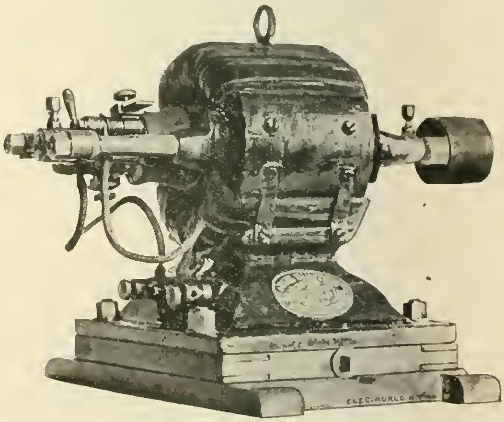
the core, and the next time the wire comes around on the outside it should be on the other side of this lag. Continue the winding until the wide lag is reached on the other side of the core. Then the layer, inside and out, should be given a good coat of the insulac, and another layer may then be wound on over it, back to the starting point and insulaced. The end of the wire may now be cut, leaving about eight inches spare and twisted around the stud on the pulley end. Do not paint this end, as the first was painted simply to make a distinction between the two. In winding on the other series coil proceed in just the same way, starting on the opposite side of the core, not next to the other side of the same wide lag the coil just wound was started beside, but the other lag on the opposite side of the core. It should be wound precisely like the one just put on, having the same numbers of layers and turns of wire. In winding on both the series and shunt coils, the shuttle should pass between the pole pieces always from the front side. Now wind a layer of tape around and completely cover both these coils, proceeding in just the same way as in taping the bare core. The remaining wire on the shuttle should be taken off and carefully coiled, or better reeled, and put away.

About four ounces of the No. 28 wire should now be wound on the shuttle and the winding of the shunt coils begun in the same places and proceeded with in exactly the same manner as with the series coils, laying on eight layers carefully and smoothly. It will be found rather trying to lay this fine wire on smooth and even with a shuttle at first starting, but it will go all right after a little has been wound; each layer should be painted with insulac. If shellac has been used the whole coil should be placed in some gentle heat and thoroughly dried out before any current is put through the wires.

There will be now four ends of wire on each side of the coil, two coming from each end of the core. Untwist all the ends from the studs and bring them up into the middle of the coil, so that the front and back ends will meet. On the coil first wound, the ends will be found to be on the upper side of the lagging, whereas they should to connect come up on the under side. Take the wood off and cut a groove across the inside large enough to allow the four wires to lay in; a piece of asbestos paper and tape should then be laid over the iron core where these wires will cross it, it being best to cut the paper the size of the lag. The wires should never be allowed to touch the iron at any spot, and should be taped where they cross under the wood, so as not to touch each other. Care is necessary in handling these ends not to break them off. Bring the four ends across under the groove and screw the lag back in place, being careful not to jam any of the coil wires or break the insulation in any place; the coils can now be placed aside to dry out.

To get the armature ready to wind, cut two washers from thick asbestos paper, or, better, a piece of the so-called "leather board" used by printers; make the washers one inch in diameter with a five-sixteenths of an inch hole and slip one on over each end of the shaft, bringing it up close to the end of the armature core. Cut off a piece of tape about one foot long and split it up and down through the middle, making two pieces. Wrap a piece around the shaft, beginning snug up against the collar (leather board), and extend out on the shaft about three-fourths of an inch on each end, letting the edges overlap. Cut from the same board twelve strips nine-sixteenths of an inch wide and three and one-quarter inches long; divide the width of each one into thirds and crease up and down its length on the marks with a knife point but do not cut in much, if any. This is done to let the sides bend up nicely and evenly. The sides are then bent up on all the strips, making twelve little troughs, which should be slipped down into the grooves in the armature core. The ends will protrude a trifle beyond the ends of the armature core, but should not be cut off but the bottom bent down so that it just laps over the end washer, and the sides will cover the corners of the projecting tooth of the core.

The armature, with a dog on the pulley end of the shaft, should be placed in the lathe with the commutator end toward the tail stock. Take the belt off and turn by hand, taking hold of the face plate; it will only have to be moved through half a revolution and back. There are many systems of winding, but in this case the Hefner-Alteneck system offers advantages to the beginner for armatures with even coils, so it will be adopted. There are twelve grooves in the core, but as one coil of wire will wind through two grooves, this only gives six complete coils or loops of wire, and as the ending wire of one coil connects up with the beginning wire of the next coil, this would give only six connecting wires to go to the commutator and there are twelve bars; besides, these wires are all on one side of the coil. This is balanced, however, by what is called splitting the coils. Only half of the total number of layers is wound at this first winding, the second half or second set being wound on over the first ones, starting them on the other side of the armature, which gives twelve connections, extending completely around the armature. With the remainder of the No. 28 wire wound on a reel suspended over the lathe and turning freely, the beginner stands in front of the lathe, taking the wire in his right hand and grasping the face plate with the left, and commences to wind. Many winders stand on the back side, but the writer thinks it easier to work from the front; the result, however, is the same. The end of the wire should be painted black, and about three inches of the end left sticking out, which may be bent round into the next groove temporarily. Commencing on the top side and in, at the commutator end, call the groove number one; wind the wire down through groove number one, over the pulley end of the core; turn the face plate from you, from left to right, and bring the wire back through the oppposite groove, or number seven; pull the face plate toward you and bring the wire up over the front end of the core, down through the first groove again, laying the second wire close beside the first strand, over the back end, through groove number seven, and so on until eight strands have been wound in,



The Completed Motor.

which will just cover the bottom of the groove. The layer and the ends of the wire must be shellaced. In crossing the heads it will be better to let the first four strands cross each head on one side of the shaft, and the remaining four on the other side; this will make the heads more even. Now the second layer may be wound on over the first and shellaced, the third over the second, and the fourth over this, shellacing each one. Fig. 20 shows the first layer of this coil wound in place. The end of the wire should be cut off, leaving four inches to spare, which should be brought across the end and twisted up temporarily with the beginning end, but not painted. The second coil should be begun in groove number two, and wound through that and groove number eight; shellac each layer and cut and twist up the ends precisely as with the first coil. Wind in four more coils in exactly the same way; when these are wound in it will be seen that the twelve grooves are half filled with wire, and the ends come out of grooves number one, two, three, four, five

and six. Now six more coils of four layers each will be wound directly over and on top of the first ones. The first coil in this second layer, or set, of coils will commence in groove number seven, and the other side of it will lay in groove number one, in which the first coil was started. It will now be seen at a glance how nicely the windings will come out. The next coil starts in number eight and winds around into number two, the next in number nine, and so on until all are wound in. Figs. 21 and 22 show the armature head with the first six coils and the whole number wound in. The ends that were twisted up merely as a convenience, and to prevent them from being broken, should now be untwisted and straightened out nicely. Take the plain, unpainted end of the first or number one coil and twist it up with the painted end of coil number two; the unpainted end of coil number two and twist it up with the painted end of coil number three; the unpainted end of coil number three and twist with the painted end of the fourth coil, and so around the whole armature. This connects the ending of one coil to the beginning of the next, forming the wire into one great loop over three hundred feet long. The ends are twisted permanently this time, and moderately tight up to the coils, where they come out of the armature.

We must now determine which way our motor armature is going to run, which, like the model, we will suppose to be from right to left, or in the opposite direction from that of the hands of a clock. The commutator should have a so-called "lead" of one bar in the direction which it shall run, in this case to the left.

In connecting the armature wires to the bars, bring the end out, and instead of connecting it to the bar directly in front of the coil, carry the wire over to the next bar to the left; cut the ends off, leaving a little more than is actually needed to solder into the bar-lug. Scrape the insulation carefully off the ends, and bring the two wires down into the little slot sawed in the lug, and solder firmly. Each end of the two wires should be brought to its respective bar and soldered into the slot in the lug. A neat little hood of thin linen should be made to draw on over these connections. It should be turned wrong side out, and the smaller end put on over the commutator lugs and bound down into the groove cut around them with thread; then it may be drawn on over itself, turned right side out and pulled up over the armature, being held in place under the end armature binder. The superfluous ends of the connecting wires protruding from the side of the lugs should be trimmed off nicely. Put a strip of thin asbestos paper around in each of the grooves turned around the armature, and over this wind on eight turns of No. 26 brass spring wire and solder it in at least six places. Trim the extra solder off smooth, and do not allow the binders to set out beyond the armature core. Cut away any tape left on the shaft on the pulley end, and put on a brass collar to prevent the wire from hitting on the end of the bearing. Set the collar with a small screw.

The armature is now complete, and should be placed in some gentle heat, to thoroughly dry out all the moisture before any current is put through the wires. If shellac is used this drying process should be continued for at least twenty-four hours. The field coils may now be connected up, and the finishing touches put on. Two small binding posts, and four 6-32 brass machine screws, three-quarters of an inch long, with four little brass set nuts, two on each, will be needed, and can be purchased at any electrical supply store. The screws go in the two middle holes, and the binding posts go in the end holes in the piece of fibre set into the base.

As the armature is to run from right to left, a north pole must be created in the left hand pole piece, and a south pole in the right hand. The builder should learn Ampere's law for the creation of magnetic poles, which is very simple, and is given in most of the electrical books for beginners; he will then understand why he makes the following connections. Untwist the ends of the field coil wires and bring them all down well under the lower coil, almost to the middle, or within a quarter of an inch of the narrow bottom lagging. A piece of tape should be put in between them and the coil wires they cross over. Take the shunt or fine wires first, and bring the painted or starting end wires of each coil together across the narrow bottom lagging, cutting a little groove across it for the wire to lay in; scrape the insulation off the wires where they cross, twist them up tight, solder and snip off the ends. A piece of tape should be put in under this wire. Now the coils should be taped over by winding on two layers, equalling four thicknesses, in the same manner as in taping the core, covering over the narrow top and bottom lags, but not the side lags. The wire ends should come through the tape near the centre of the bottom side. The top part of the base casting should be chipped out to fit up to the curve of the under side of the field, so that it rests firmly, and held in place by the four brass straps, two of which are shown in the picture of the finished motor. Put in a couple of thicknesses of asbestos paper between the iron and the field coil.

To complete connecting up, take the unpainted ends of the series coil wires (the larger ones), scrape the insulation off nearly to the core, say to within one inch of it, and solder the ends to the binding post screws. Do not draw the wires tight, but leave quite a sag, and slip on a piece of soft rubber tube over each before soldering. The left wire goes to the left hand binding post screw, the right to the right hand binding post screw. The painted or beginning ends of the series coils, and the unpainted or ending ends of the shunt coils, should be joined to each other and to the brushes. Take those on the left hand side first; scrape off the insulation of the series and shunt wires, twist together tight and solder; slip on over a piece of soft rubber tube and again solder to the end of the screw holding the cable going to the lower brush. The two corresponding wires on the right hand side should be treated in the same way, and the ends soldered to the end of the screw holding the cable going to the top brush.

The motor is now practically completed, and may be tested on any direct current of from fifty to fifty-five volts, and will work all right if these instructions have been carefully followed. The painting may be done to suit the builder; the model illustrated was given four coats of blue black enamel and then baked. The supply of current may be taken from any lamp socket by using a plug, screwing in to the socket in place of a lamp, with cord attached. It makes no difference at which binding post the current enters, the result being the same. The motor just described is no toy, but a powerful and practical machine, developing on a fifty-five volt current a power of over an eighth of a horse-power, though considerably less than half the size of any of the one-eighth horse-power motors now on the market. In belting from the motor, connect to as large a pulley as possible and practical, and use a heavy duck tape, one inch wide, such as printers use on their large presses.

This motor is of the style known as the two-pole, double-magnet type, and the model weighs nine and three-quarters pounds. The builder may enlarge this motor, keeping the proportions in a relative ratio and make a much heavier field core, having it cast from steel, thus making a much more powerful machine. The pole pieces can then be cast in one piece with the field core. In building any larger motors, the writer advises, if they are to be run in multiple, that a rheostat, or a starting box be used, placed in series with the armature, even if the motor is self-regulating.

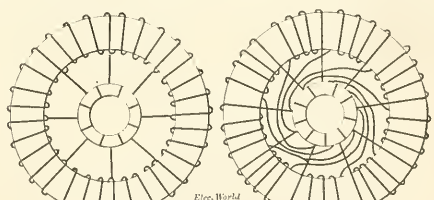
Practical Notes on Dynamo Calculation.—XI.

BY ALFRED E. WIENER.

25. Types of Armature Winding.

a. Closed Coil Winding and Open Coil Winding.

If, in a continuous current dynamo, the reversal of the current would take place in all the conductors at once, considerable fluctuation of the E. M. F. would be the result. In order to obtain a



FIGS. 32 AND 33.

steady current, the armature conductors are, therefore, to be so arranged, relative to the poles, that a portion of them is in the strongest part of the field, while others are exposed to a weaker field, and some even are in the neutral position.

After having thus arranged the conductors, their connecting can be effected by one of the following two methods:

1. All conductors are connected among each other so as to form an endless winding, closed in itself, and consisting of two or more

*ERRATA.—In section 24, page 58, of the last issue, the simplified form of the attraction formula in G. C. S. units should read $= G' \times \frac{\mathcal{H}_1^{\,2}}{16\,\pi}$; in formula (60), same page, the term $\left(\frac{\mathcal{H}_1}{6.45}\right)^2$ should be replaced by $\left(\frac{\mathcal{H}_1}{6.45}\right)^2$; Figs 22 and 24, same page, should be exchanged; Fig. 22 is intended for a horizontal machine and should be in a horizontal position, in place of Fig. 24, and vice versa.

parallel branches, in each of which all the single E. M. F's. induced have the same direction, and in which the reversal of the current occurs in such conductors only that at the time are in the

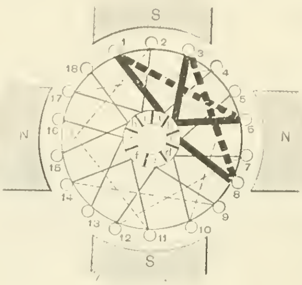


Fig. 34

neutral position. An armature with such connections is called a "closed coil armature."

II. The conductors are joined into groups, each group containing all such conductors in series which, relative to the field, have exactly the same position; and the current is taken off from such groups only which at the time have the maximum, or nearly the maximum, E. M. F., all other groups being at that time cut out altogether. An armature wound in this manner is styled an "open coil armature."

b. Spiral Winding, Lap Winding and Wave Winding.

According to the manner in which the connecting of the con-

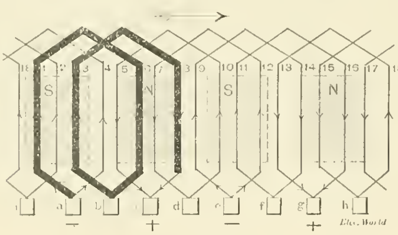


Fig. 35.

ductors by the above two methods is performed, the following types of armature windings can be distinguished: (1) Spiral winding, or ring winding, Figs. 32 and 33; (2) lap winding, or loop winding, Figs. 34 and 35; (3) wave winding, or zigzag winding, Figs. 36 and 37.

In the spiral winding, Figs. 32 and 33, which can be applied in the case of ring armatures only, the connecting conductors are

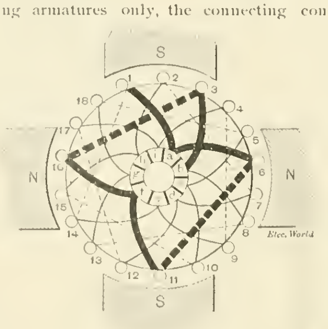


Fig. 36.

carried through the interior of the ring core, and the winding thus constitutes either one continuous spiral, Fig. 32, from which, at equal intervals, branch connections are led to the commutator or a set of independent spirals, Fig. 33, which are separately connected to the commutator.

The lap winding, as well as the wave winding, is executed entirely exterior to the core, and can be applied to both drum and ring armatures.

In the lap winding, Figs. 34 and 35, the end of each coil, consisting of two or more conductors situated in fields of opposite polarity, is connected through a commutator segment to the beginning of a coil lying within the arc embraced by the former. With reference to the direction of connecting, therefore, the beginning of every following coil lies back of the end of the foregoing, and

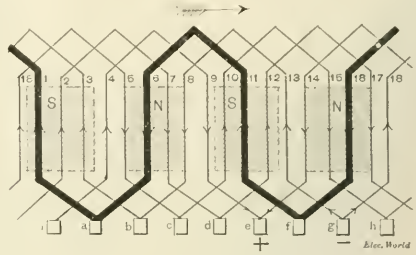


Fig. 37.

the winding, consequently, forms a series of loops, which overlap each other. Fig. 34 represents such a lap winding for a four-pole drum armature, the development of which, Fig. 35, more clearly shows the forming of the loops and the manner of their overlapping.

In the wave winding, Figs. 36 and 37, the connecting continually advances in one direction, the end of each coil being connected to the beginning of the one having a corresponding position under the next magnet pole; and the winding, in consequence, represents itself in a zigzag, or wave shape. The wave winding is illustrated in Fig. 36, and for better comparison the same four-pole drum armature is chosen that in Fig. 34, is shown with a lap winding. The development given in Fig. 37 distinctly shows the zigzag form of the wave winding.

In multipolar machines, the wave winding can be used for series as well as for parallel connection; the lap winding, however, for parallel grouping only.

While the lap winding necessitates as many sets of brushes as

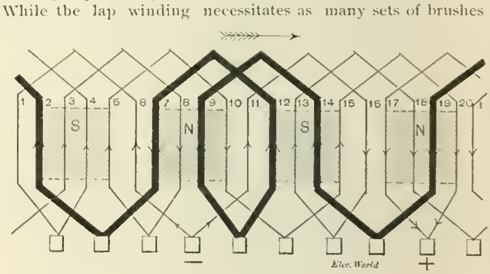


Fig. 38.

there are magnet poles, the wave winding for any number of poles invariably needs but two sets of brushes.

For series-parallel connection, either wave winding may be used or lap and wave windings may be combined. Fig. 38 represents the development of such a "mixed winding," the coils partly being connected in the lap and partly in the wave fashion. This winding, like the wave winding, has the peculiarity of requiring but two sets of brushes, independently of the number of magnet poles.

(To be continued.)

Death of Edmond Julien.

Edmond Julien, the distinguished engineer and founder of what is known in this country and Europe as the Julien system, expired at his home in Brussels on the 5th day of this month. Mr. Julien was born at Ardenne, on the 31st day of August, 1838. He was by profession a civil engineer, and in that capacity built a number of railroads in Russia and Spain. He had the reputation of being of the first rank as a railroad engineer. He amassed considerable wealth in railroad building, and embarked almost all of it in the storage battery business, in connection with Faure and Phillipart. He built what was probably the first storage battery factory in Europe, at Brussels, and in 1885 his storage battery car took the first prize in mechanical traction at the Antwerp Exposition. Mr. Julien was highly esteemed by his fellow citizens at Brussels, and King Leopold knighted him in 1889. He was a man of most imposing appearance, being nearly 6 feet 4 inches in height, and of splendid proportions.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING.

ELEC WORLD, N.Y.

ELECTRO-PHYSICS.

Phosphorescence at Low Temperature.—According to the Lond. "Elec." and "Elec. Eng.," July 6, Prof. Dewar, in his experiments with temperatures of 180 degrees C below zero, found that although chemical action almost ceases, photographic action does not, but is diminished by 80 per cent.; gelatine, celluloid and other substances were very luminous when exposed for a second to the beam of a strong electric light; from his experiments he is led to the generalization that the more complex a body is in structure the more likely it is to phosphoresce; pure water is weakly phosphorescent, but if very sightly impure it becomes strongly so; phosphorescence is due to some kind of molecular change in the oxygen, which is demonstrated by the fact that ozone is formed during the process.

Nature of Electric Conductivity.—In a paper by Mr. Vaschy from "Comptes Rendus," vol. 118, p. 1,324, abstracted in "La Lum. Elec.," June 30, he points out that electric conductivity appears to be a tendency of the electric field established in a body to dissipate in a greater or less time; magnetic conductivity does not exist, as a field once created is permanent, thus forming a characteristic difference between the properties of electric and magnetic forms of energy.

Analyzing Periodic Functions.—A number of instruments for performing such analysis are described and illustrated by Mr. Hess in "La Lum. Elec.," June 23.

Influence of Pressure on the Dielectric Constant.—A paper by Mr. Roentgen from "Wied. Ann.," vol. 52, p. 592, is abstracted in "La Lum. Elec.," June 23.

Afterglow in Geissler Tubes.—The article abstracted in the Digest, June 23, is abstracted at greater length in the "Elek. Zeit.," June 28.

The Work of Hertz.—The Lond. "Elec.," July 6, publishes some corrections and explanations by Dr. Oliver Lodge, in connection with his recent lecture, which was referred to recently in these columns.

Vortex Theory of Electro-dynamics.—The article by Mr. Blondin is continued in "La Lum. Elec.," June 23 and 30.

MAGNETISM.

Magnetic Lag.—In a paper by Prof. Dechant, abstracted in the "Zeit. fuer Elek.," April 15 (just received), he discusses the lag in the propagation of magnetism generated by currents of different phases encircling a common core; the propagation of the magnetic waves is calculated from the distance between the magnetizing coils divided by the phase difference in seconds; it was found to be 12 metres (per second) with an alternating current of 40 periods, a phase difference of one-third period, and a distance of 10 cm. between the coils; the most sensitive means of showing the existence of these waves was a thin round disc of iron, 0.1 mm. thick; he showed that the rotation of this disc can be explained only by hysteresis; also that the disc also rotated externally to the coils, which is possible only when the diminution in the magnetization along the rod does not follow a geometric progression; with a closed magnetic circuit he showed that this diminution is an important factor in the production of the magnetic lag.

Magnetization of Alloys.—A Royal Society paper on "The Effect of Mechanical Stress and of Magnetization on the Physical Properties of Alloys of Iron and Nickel and Manganese Steel," by Mr. Tomlinson, is published in abstract in the Lond. "Elec.," July 6.

The Effect of Magnetization on the Dimensions of Wires and Rings.—A Royal Society paper by Mr. Bidwell is abstracted in "La Lum. Elec.," June 30.

Magnetization by Rapid Electric Oscillations.—A paper by Mr. Klemencic, on the magnetization of iron and nickel wires is abstracted in "La Lum. Elec.," June 23.

Magnetization by Hertzian Currents and a Magnetic Dielectric.—The article by Mr. Birkeland from "Comptes Rendus," vol. 118, p. 1,320, is abstracted in "La Lum. Elec.," June 23.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Efficiency of a Large Motor.—In a paper by Mr. Rey in the "Bul. Soc. Int." for June, abstracted in "La Lum. Elec." June 16, he describes in detail the testing of a 720 h. p. motor, made for the submarine boat "Gustave-Zédé," by the Hopkinson method; the motor had six poles and two identical armatures, coupled in parallel and keyed to the shaft; these armatures were connected in series and in opposition as in the Hopkinson method. The theory is discussed at some length and the results of the tests given; he deduces two approximate formulas as also the complete formula.

Measuring the Magnetic Qualities of Iron.—A translation of the article by Dr. Koepsel, mentioned in the Digest May 12, is given in abstract in the Lond. "Elec.," July 6, together with the illustrations. In an editorial discussion attention is called to the fact that a small error in B may produce a large variation in the area of the curve, a point which is important in connection with transformers; it is suggested that it might simplify matters to make it a torsional, zero reading instrument, thus doing away with the compensation.

Measuring the Resistance of Electrolytes.—A translation of Prof. Kohlrausch's article, from "Wied. Ann." vol. 51, page 347, is given in "La Lum. Elec.," June 16; several forms of electrodes are described and illustrated for facilitating the determination of the resistance of electrolytes.

Platinized Glass Resistances.—According to the Lond. "Elec.," July 6, Mr. Mergier before the French Physical Society recommends the use of platinized glass for high resistances; a sheet 3 by 4½ inches will give a resistance varying from 25 to 100,000 ohms; they are mounted in a closed bottle containing petroleum and a layer of mercury at the bottom, enabling the resistance to be varied.

Photometric Standard. In the recent Physical Society paper by Captain Abney, abstracted briefly in the Lond. "Elec.," July 6, he states that from photographs he finds that when used with a slit as a photometric standard the Argand burner is unsuitable, for portions of different luminosity come into view when the slit is approached or receded from; the ordinary fishtail burner was better in this respect.

Pupillometry and Photometry.—Mr. Henry's article is continued in "La Lum. Elec.," June 16, the present portion being devoted to the eye and the pupil. The article appears to be concluded in the issue of June 30.

Resistance of Pure Water.—The article by Profs. Kohlrausch and Heydweiller, abstracted in the Digest June 16, i abstracted in the "Elek. Zeit.," June 28.

Conductivity of Salts in Aethyl and Methyl Alcohol.—An article by Mr. Voelmer is abstracted briefly in the "Elek. Zeit.," June 28.

Physical Quantities.—A paper by Mr. Rovida, summarizing the laws of the actions and the systems of the dimensions of physical quantities, is published in "La Lum. Elec.," June 30.

Electrolytic Meters.—"Ind. and Iron," June 22, publishes an article on this subject, containing, however, nothing new.

DYNAMOS AND MOTORS.

Classification of Dynamos and Transformers.—In a short article by Prof. Blondel, in "La Lum. Elec.," June 16, he points out the importance of more specific and more rational terms in connection with generators and transformers, and suggests the following classification. He divides generators, including alternating as well as continuous, into two classes, those with a discontinuous winding and those with a continuous winding, each class being divided into types with ring, drum or disc armatures and into those with exterior and interior armatures; when machines generate at the same time continuous and alternating currents he recommends the term "polymorphic," suggested by Mr. Hospitalier; the terms "di-alternator and tri-alternator" or "duplex" and "triplex" alternators are suggested when the machines deliver two or three phase currents. Transforming apparatus he divides into "redresseurs" (also known as rectifiers); "transformers" which transform by induction a primary into a secondary current of the same nature, divided again into continuous current, simple alternating current and polyphase current

transformers, 'converters' for converting by induction a primary into a secondary current of a different nature, divided into rotating converters with continuous current windings and converters with stationary flux ("a flux fixe") such as those of Scott and of Hutin & Leblanc.

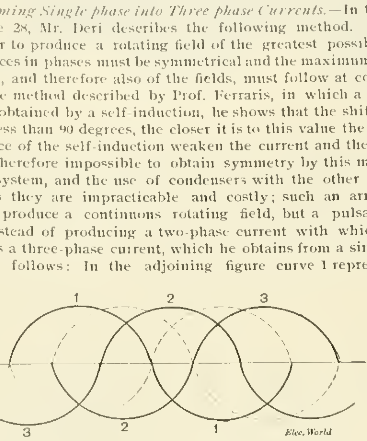
Sine Curve Alternators.—The Lond. "Elec.," July 6, ridicules the practice of some American companies in building true sine curve alternators; "probably an alternator with a true sine curve, even though it may disdain to run in parallel with a machine having a more bactrian characteristic, is little or no better intrinsically in a commercial point of view than a less highly bred article."

New Synchronous Motor.—"La Lum. Elec.," June 23, contains a short description and discussion of the new motor suggested by Prof. Ferraris, mentioned in the Digest, June 16.

Starting Single Phase Motors.—See abstract under "Transforming Single-phase into Three phase Currents."

TRANSFORMERS.

Transforming Single phase into Three phase Currents.—In the "Elek. Zeit.," June 28, Mr. Deri describes the following method. He states that in order to produce a rotating field of the greatest possible effect, the differences in phases must be symmetrical and the maximum values of the currents, and therefore also of the fields, must follow at equal intervals. In the method described by Prof. Ferraris, in which a difference of phase is obtained by a self-induction, he shows that the shifting must always be less than 90 degrees, the closer it is to this value the more will the resistance of the self-induction weaken the current and therefore the field; it is therefore impossible to obtain symmetry by this means in a two-phase system, and the use of condensers with the other current is excluded as they are impracticable and costly; such an arrangement would not produce a continuous rotating field, but a pulsating one. Mr. Deri instead of producing a two-phase current with which to start motors, uses a three-phase current, which he obtains from a single-phase current as follows: In the adjoining figure curve 1 represents the



Transforming Single-Phased into Three-Phased Currents.

original current, curve 3 is a shunt from this in which the phase has been shifted 60 degrees by means of a self-induction; the effect of the intermediate phase, curve 2, is obtained by two equal windings, through one of which current 1 is passed in the reverse direction, and through the other of which current 3 is passed in the reversed direction, as shown by the dotted lines; the combination of the two currents shown in dotted lines is equivalent to the curve 2, shown in full lines; he assumes that the currents follow the sine law; strictly speaking the current 3 is shifted through 60 degrees and the connections reversed, so as to reverse the current, thus producing a shifting of 240 degrees. A simple theoretical deduction is given. In order to meet the condition that the maximum intensities of the fields and the currents 1 and 3 are equal, he either inserts a resistance in one of them, or uses different voltages in the two branches. (Precisely the same invention was described and illustrated under "Alternating Current Motor" in the Digest, Nov. 11, 1893.)

Current-Rushes in Transformers.—Mr. Hay's article, abstracted in the Digest last week, is continued in the Lond. "Elec.," July 6; curves and results are given showing a general agreement between the theoretical and experimental results; for constant permeability, he sums up the knowledge regarding such rushes as follows: (1) "The phenomenon of a 'Current-rush' (accompanied by a corresponding 'rush' of magnetic induction) consists in the appearance, at the instant of closing the circuit, of certain abnormal waves, which gradually become modified so as to assume the normal form. (2) The distortion of the initial waves consists in an enlargement of one set of half-waves, accompanied by a reduction of the other set. As time goes on, the abnormal half waves diminish in size, and the abnormally small ones increase, until a state of equality is reached, which is the normal state. (3) The current-rush is a function of the resistance and inductance of the circuit; it increases with the latter and diminishes with the former. In no case, however, can it attain the value 2. (4) The change from the abnormal to the normal state takes place comparatively rapidly at first, then more and more slowly. In all cases where there is a considerable rush, an interval of time corresponding to several periods must elapse before an even approximately normal state can be reached. (5) The damping of the abnormal waves is due entirely to the resistance of the circuit." If the circuit could be deprived entirely of resistance, he shows that the waves would preserve their initial type without undergoing any modification, and that they would lie entirely above the time axis, or in other words, a simple harmonic E. M. F. would produce, not an alternating, but a uni-directional fluctuating current, and that the magnetic induction would always be of the same sign; by increasing the time constant, current-rushes can be obtained which do not fall far short of two, and the waves of which will preserve their type for a considerable number of periods.

In the same issue Prof. Fleming calls attention to the fact that he was the first to point out the effect of current-rushes in a paper read in 1892; he believes that Mr. Hay will find that the experimental evidence is not quite in accord with the simple theory which he advances, and that he, Fleming, had abandoned that theory long ago, as it did not explain well ascertained facts.

Transformer Systems.—The Lond. "Elec. Rev.," July 6, contains a communication from Mr. Whitcher, advocating a system in which a third main is used, making two circuits, one of which can be completely cut off during the hours of light load.

ARC AND INCANDESCENT LIGHTS.

Incandescent Lamp.—A long paper by Mr. Larnaude on the present state of its manufacture is published in the "Bul. Soc. Int." for June, a long abstract being reprinted in "L'Ind. Elec.," June 25. The article is interesting reading, but contains little that is new; he points out the advantages in forcing the lamps, stating that at the present low price of the lamps it is more economical to force them and replace them more frequently; curves are given showing the variation in the candle power for a range of 20 volts on each side of the normal; also the efficiencies in watts per candle. From some experiments of which he gives the results, he shows that the loss in the light of a lamp after it has been run for some time is due about equally to the consumption of the filament and to the blackening of the bulb; in these experiments the bulbs were cleaned by admitting the air to the blackened bulb, the bulb being then heated to a nearly red heat, which causes the carbon deposit to disappear, after which the lamp was again sealed, the air exhausted, and the test made. He speaks of the advantages and disadvantages of using metallic oxides in place of the carbon for the filament, suggesting that some such material as silicide of carbon might be used, stating that the recent experiments of Mr. Moissan have shown that this material could probably be manufactured without the same difficulty as heretofore. He gives the temperature of volatilization of carbon as 1,700 degrees C. stating that incandescent lamps must be run below this temperature. He speaks favorably of a process of making the filament, which he describes, in which a plastic carbon mixture is pressed out in the form of wires through dies. In comparing the cost of the light from an arc and an incandescent light, each of 500 candles, he concludes that the cost of the latter is twice as great.

Electric Light in Warfare.—According to the Lond. "Elec. Eng.," July 6, an ingenious device is used in the German army to prevent the enemy from locating the position of the plant used for an electric search light; the light from the projector is thrown on a mirror about 600 feet distant, from which it is reflected to the required point; the mirror is operated by an electric motor, which is controlled from a distance. (The moisture so often found in the atmosphere of Germany, or a small amount of smoke would, however, soon reveal the position of the reflector itself.)

Projectors.—A number of systems are described and well illustrated by Mr. Richard in "La Lum. Elec.," June 23.

TRANSMISSION OF POWER.

A Continuous Alternating Current Transmission System.—Prompted by some comments made in the Digest last year regarding the laboratory nature of the inventions of Messrs. Hutin and Leblanc, Mr. Guilbert publishes in "La Lum. Elec," June 16, a profusely illustrated description of a novel plant which has been in regular operation for several months in transmitting power from La Chapelle to Epinay. In American journals, he states, there is a tendency to publish artistic illustrations of the outside of a machine, which give no idea of its principle or of its operation, while in France it is preferred to give detailed descriptions in an intelligent manner, showing the principle and operation; (these remarks intended presumably as a reply to the comments above referred to, do not, however, meet the case, which referred to practical apparatus as distinguished from mere suggestions). In this plant a low tension, continuous current is converted into a high tension three-phase alternating current by the machine called a "panchahuteur"; these are transmitted over the line and in a similar machine are again transformed down to a continuous low tension current and used for charging accumulators for lighting a railway station; the original continuous current voltage is between 110 and 170, the alternating current voltage is between 4,000 and 5,000, the line currents about 1 ampere, the distance almost 5 miles and the final voltage about the same as the original; the original current is from 60 to 70 amperes, and the final current from 40 to 50; the efficiency of the transmission without considering the line loss is between 75 and 78 per cent. for about 12.5 kilowatts delivered at the farther end; including the line losses, the total efficiency of the plant appears to be about 60 to 68 per cent.; it is believed that by making changes and improvements in the apparatus, the efficiency can be increased to 90 per cent.; the important loss of energy is that in the motors, which can be greatly reduced if desired. The general principle of the transforming machines, which are similar to each other, is that the continuous current is transformed into a tri phase alternating current by means of a commutator driven by a motor, these currents being then transformed into high tension currents. The article contains 20 illustrations showing the connections in the apparatus, several external views and a number of curves of efficiencies under various conditions. The receiving apparatus is driven by a synchronous motor, absolute synchronism being obtained by a special device; the moving of the brushes for different loads is accomplished automatically and there is said to be no sparking; the motor does not start by itself, but it is said that a few turns by hand are sufficient; even this difficulty however can be overcome; it is believed that the apparatus can be sim-

plified very greatly, this being the first installation; he believes this system can be used with success for considerably increasing the carrying capacity of feeders. Several tables giving quite complete experimental data under various conditions, are included. Regarding Mr. Scott's system for transforming di-phase into tri-phase currents, he believes that too much stress has been put on this invention, stating that the principle is so simple that it is quite probable that it has been indicated before; he explains briefly a solution of the problem by Messrs. Hutin and Leblanc. A short abstract of this article is published in the Lond. "Elec. Eng.," July 6.

Continuous Current Transmission.—The installation at Sigmaringen is illustrated and described in the "Elek. Zeit.," June 28. A very brief abstract is given in the Lond. "Elec. Eng.," June 6. Two series dynamos of 90 h. p. are driven by turbines generating a continuous current of 1,100 volts and 61 amperes; they are connected in series but as a precaution a third wire is used, making it a true three-wire system; the arrangements of the switchboard connections are given; the distance is 3 miles, the wires being overhead; at the secondary station the current is transformed by continuous current transformers; the starting is done entirely at the primary station, a shunt to the magnet winding being adjusted after the turbines are started so as to generate a gradually increasing current, the motors beginning to start with a current of 20 amperes and 200 volts; to stop them this operation is reversed. Safety apparatus is provided, there being an automatic current interrupter to provide against open circuits and a field short-circuiting apparatus to provide against short circuits.

ELECTRIC RAILWAYS.

Accumulators in Power Houses.—The interesting railway from Zurich to Hirslanden is described and illustrated in the "Elek. Zeit.," June 28; it is said to be the first railway plant in which accumulators are used at the power houses to equalize the load, and the installation is said to be very successful. The article includes a diagram of the complete connections at the station; the dynamo delivers a current of constant intensity, accumulators being charged or discharged as the load on the line is less or greater than that of the dynamo; by means of automatic arrangements, shown in the diagram, the number of cells at the end of the accumulators is automatically cut into or out of the circuit to keep the voltage constant; the dynamo charges all but the cells at the extreme end, the latter being charged by a separate small dynamo with the aid of an automatic device. Results are given showing that there is a saving due to the use of accumulators of 2.2 lbs. of coal per h. p. hour, amounting to almost a ton of coal a day, representing a saving of about $2,500 a year; the cost of the accumulators with the accompanying apparatus was about $7,400; allowing for interest and repairs of accumulators, it is shown that their cost is saved in about 4 years by the saving of the coal; this saving is due chiefly to the fact that it is not necessary to keep in reserve a second boiler and steam engine, and that by this arrangement the steam engine is running continually at its best efficiency; besides this, the total installation is cheaper than without accumulators, as the latter cost less than the machinery and increased plant which they replace. The present plant contains two main dynamos and engines of 90 h. p. each, one set serving as a reserve.

Accumulator Traction on Ordinary Roads.—"Ind. and Iron," June 15, gives the opinions of several accumulator manufacturers on this subject. Mr. Epstein does not think there is any insuperable objection, stating that he is at present constructing several electric vehicles in the shape of the "Victoria" intended for 4 passengers; the vehicle weighs 1 cwt., accumulator 4, motor of 1.5 h. p., 3 cwt., and 4 passengers at 5.5. making a total of 13.5 cwt.; on account of the dead weight he believes that only small vehicles are practicable. He believes that improvements in accumulators will be made, and states having obtained results which open up great prospects. Mr. Niblett believes that accumulators will have to be greatly improved before such travel becomes practicable; he has very little hope for the efforts that are being made with such vehicles; although only about 4 amperes (presumably ampere hours) per pound are obtained, he believes that 18 to 20 will be attainable; which he bases on his experiments with lithanode plates. He believes that the time is rapidly approaching when every vehicle in the street will be propelled by stored electricity, but states that first the defects in existing accumulators must be removed. Mr. Drake concludes that traction with accumulators on anything but a level is a practicable impossibility, either now or at any future period. The issue of June 22 contains a communication by Mr. Ward, who favors such traction, basing his opinion on practice; he ran the first electrical omnibus in London for over 5 000 miles. The issue of June 29 contains another correspondence by Mr. Niblett.

Electric Railways.—The paper by Mr. Hammond, mentioned in the Digest last week, is published in abstract in the Lond. "Elec. Eng.," July 6. It appears to be made up largely, if not entirely, of information already published; it is discussed unfavorably in the leading editorial of the Lond. "Elec. Rev.," together with several recently established systems of a complicated nature, among them being the Patton system, which is being tried in Chicago.

Heilmann Locomotive.—"La Lum. Elec.," June 16, gives a diagram of the complete connections, and describes an improvement in which it is intended to proportion the power of the steam engine to the variable resistance of the train by exciting the magnets of the generator by a special dynamo run by a separate engine.

The Behr High Speed System.—"La Lum. Elec.," June 16, publishes a number of good illustrations, together with a short description, of the high speed system which is being exploited by Mr. Behr in England; it is a single rail system.

Underground Railway at Budapest.—This underground road is to be laid immediately below the pavement, and is therefore not in the nature of a tunnel road; the contact rail will be fastened along the sides of the road and not between the rails.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Alternating Arc Light Installation.—The installation at Hastings is described briefly in the Lond. "Elec. Rev.," July 6; the lamps are arranged in parallel across the 2,000 volt mains, a small transformer in each lamp performing the necessary conversion; "the lamps may be turned on or off from the central stations by using one return wire only," a further description of which, however, is not given; the difficulty lies in insulating the lamp as a whole.

Plug Switch. A switch devised by Dr. May, which is said to comply with all the requirements of the German insurance companies, is illustrated and described in the "Elek. Zeit.," June 28.

Gas vs. Steam for Central Stations.—An article in the Lond "Elec. Eng.," July 6, gives the detailed estimates of the prime cost and the cost of operation of a large and a small plant, using in one case steam and in the other a Dowson gas plant, showing a balance in favor of steam in both first cost and cost of operating.

Turbine.—The Seger steam turbine is briefly described and illustrated in "La Lum. Elec.," June 16. According to the issue of June 23, the Oerlikon Company has recently constructed a 5 h p. Laval turbine dynamo, the speed of which is 30,000, that of the dynamo 3,000, and the steam consumption 36.5 lbs. per h. p. hour.

Petroleum Motors.—A recent set of competitive tests made in Paris with small petroleum motors is mentioned in "La Lum. Elec.," June 16; the highest prize was awarded to the Merlin motor.

WIRES, WIRING AND CONDUITS.

Ship Wiring. A new system is described in the Lond. "Elec. Rev.," July 6, and termed an almost jointless one; mains are run from a distributing board, from which the whole lighting is manipulated; from there mains are run to small subsidiary boards placed in accessible parts of the ship, each for groups of from 6 to 8 lamps, the switching on and off being usually done from these boards; from these, separate leads run to each lamp, so that the only joints are at the distribution boards. The increased cost is said to be only 10 per cent. of the cost of the wire, which extra cost is said to be compensated for in other ways, among them being the saving in labor in making connections.

Underground Cable for Low Tension Currents.—A new cable of Messrs. Felten and Guillaume, in which the conductor is made in the form of a composite tube, is described and illustrated in "La Lum. Elec.," June 30.

Deflection of Poles for Overhead Lines.—A mathematical article on this subject is published by Mr. Colard in "La Lum. Elec.," June 23.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Between Egypt and the Cape.—"La Lum. Elec.," June 30, discusses Mr. Rhodes's proposal to connect Egypt with the Cape by a transcontinental line.

Pacific Cable.—A note regarding the Ottawa Conference is contained in the Lond. "Elec. Eng.," July 6. Several letters from the Canadian Blue Book are published in the same issue.

New Caledonian Cable.—A long illustrated paper by Mr. Reynier giving the history, construction and laying of this cable, is published in the "Bul. Soc. Int." for June.

Automatic Block System.—The Seaton and the Tyer systems are described and illustrated in "La Lum. Elec.," June 23.

ELECTRO-CHEMISTRY.

Primary Batteries for Lighting.—The Barruet system is described and illustrated in "La Lum. Elec.," June 23; it has been in use for several years; the cost per kilowatt is not given; but is admitted to be greater than that obtained with dynamos, but not too great for installations, in which the cost is not the principal consideration; a modified sulphate of copper battery with circulating liquids is used to charge accumulators successively, in groups of two or three, by an automatic apparatus. (In an article in "Ind. and Iron," June 29, the Fulgur battery, quite similar to the above, is briefly described.) The London "Elec. Rev.," July 6, discusses the Fulgur and Barruet primary batteries, expressing its opinion that there is no great future of primary batteries for lighting purposes.

Schoop Accumulator.—Devices for keeping the liquid in constant circulation are illustrated and briefly described in "La Lum. Elec.," June 30.

Minimum E. M. F. of Electrolysis.—A paper by Mr. Nourisson is abstracted briefly in the "Elek. Zeit.," June 28; he demonstrates that the minimum E. M. F. for the electrolysis of alkaline salts in solution is constant for all the salts of the same acid; the calculated and observed values are given, the former being: for acid compounds of chlorine, 2.02; bromine, 1.75; iodine, 1.16; sulphate, 2.15; nitrate, 2.07, and chlorate, 2.07.

Electric Tanning.—The Humy system is illustrated in "La Lum. Elec.," June 16; the leather passes between rolls, which act as the electrodes; the electrothermic action of the current facilitates the penetration and subsequent action of the tannin, as also the absorption of the materials intended to increase the weight.

Electric Pickling Bath. Pickling baths become saturated, thus entailing an expense for renewal; to avoid this Mr. Heathfield, according to "La Lum. Elec.," June 23, uses an electric current in such a bath, the piece to be pickled forming the anode; the acidity of the bath is thus maintained indefinitely.

Brewery Analysis.—An electrical process, which is said to have shown remarkable accuracy, is mentioned in the Lond. "Elec. Rev.," July 6; the amount of invert sugar, which it is very important to determine, is measured by means of a copper solution, the quantitative determination being made by means of electrolysis.

MISCELLANEOUS.

Death by Electricity.—The "Elek. Zeit.," June 28, abstracts a paper read at the recent Medical Congress at Rome. Experiments were made with animals, the current being an alternating one; death resulted mostly by the sudden stopping of respiration, which stoppage caused death by asphyxia; the heart action continues for about two minutes, after which secondary cessation of heart action takes place, causing death; frequently however, breathing started again spontaneously and the animal recovered completely; with a current of 1,500 to 2,000 volts, the killing was not sure and easy; the danger increases in proportion to the higher development of the brain and therefore human beings are more easily affected than animals. Sometimes death takes place suddenly through the instantaneous cessation of heart action; a gradual paralysis of heart action, as noticed in human beings, could not be produced experimentally; in none of these cases was there any anatomical change to which death could be ascribed; in a few cases there was mechanical lesion in the form of a rupture of the blood vessels and internal hemorrhage, in which case the animals died of pressure on the brain after quite a number of hours.

Fatal Accident.—The English journals of July 6 report a fatal accident which occurred at the 10,000 volt mains at the Deptford plant.

Treatment of Trigeminal Neuralgia.—A more or less successful electrical treatment is described in an abstract from the "Lancet" in the Lond. "Elec. Rev.," July 6.

Discovering Flaws in Iron and Steel.—An apparatus is mentioned but not described in "Ind. and Iron," June 29; it appears to consist of small pneumatic tapper, worked by hand, which is made to tap over the piece to be tested; it is in some way connected with a telephone in which a false sound, quite distinguishable from the normal sound, is heard when a spot in the neighborhood of a flaw is reached.

Electric Brake.—A band brake operated by an electromagnet for instantly stopping machinery is mentioned in "La Lum. Elec.," June 16; in case of an accident the workmen in a factory need only break the glass cover of an apparatus in order to stop ordinary machinery in about one second, and the most powerful machinery in from two to three seconds.

Electric Flying Machine.—According to the "Elec. Tech.," June 15, some recent experiments made at the high school at Bruenn, with a small model, proved successful and promising; a double wheel with sails, driven by an electric motor, raises itself and could be propelled horizontally. The same journal states that the 50 foot wheel for the Wellner flying machine has been completed and will soon be used for making tests.

Automatic Steering Compass.—The device mentioned in the Digest June 2 is described in the Lond. "Elec. Eng.," July 6.

Artificial Rain.—According to a quotation from "Comptes Rendus," vol. 117, p. 566, Mr. Baudouin has succeeded in producing rain by conducting the electricity from the clouds by means of a kite.

Fire Damp.—According to "La Lum. Elec.," June 30, Mr. Delaurier, in a note before the French Academy, suggests igniting the fire damp in mines, as quickly as it is produced, by means of electric sparks.

Index to Literature.—According to "La Lum. Elec.," June 16, a publication is to be started in Vienna in July, in the form of a universal index of scientific and technical literature; each number is to contain a list of the periodic publications classified according to subjects and giving the titles, table of contents, subscription price, place of publication, etc.

Entropy.—A statement by Prof. Lodge advocating the conception of entropy to engineers is given in the Lond. "Elec.," July 6.

Biographical.—A translation of the memorial address by Prof. Ebert on "Heinrich Hertz" is published in the Lond. "Elec.," July 6.

The Scenograph.

The scenograph is the latest development of the cycloramic art. It is now on exhibition at the Madison Square Garden, where it is attracting considerable attention by the brilliancy of its effects and the fidelity of its representations. The scene depicted is the World's Fair, and the spectator gazes at the White City from the point of view of the aeronaut whose balloon is some 300 feet off shore and 600 feet above the lake.

The view is at night, of course, and every building on the grounds is sparkling with light. Every electrical effect is produced in miniature precisely as the larger real effects were produced at the Fair. Even the McMonnies Fountain is a practical fac-simile of the original. The boat on the lake are independent affairs whose propellers are worked by their own little motors. There is a small search light on the Manufactures Building whose hundred-candle power light sends its beams into the perspective distance. In the background the Midway Plaisance with the big Ferris wheel is shown. The wheel goes around and nearby the captive balloon rises up and down at intervals. One feature of the exhibition is that the modeled and painted houses are geographically correct. It is said that every hotel near the grounds can be pointed out and most of the houses in Chicago are represented, even to the one in which Carter Harrison was shot. On the right, Mackaye's ill-fated Spectatorium is shown, while on the left the moving sidewalk is seen.

The electrical effect is very beautiful. There are 600 16 c. p. lamps in operation besides the myriads of miniature specks of flame which light up the sidewalks. Mr. D. J. Buckley, the electrician, is authority for the statement that there are one thousand separate 122 volt circuits. The McMonnies fountain is done in five colors and even the lighthouse has its revolving lamp just as do its prototypes on a larger scale. The power is supplied from the Madison Square Garden plant.

Everything is built on a scale of one to sixty, and so accurate is the representation that every night people bring with them opera glasses and succeed in pointing out the house, or hotel, in which they stopped while in Chicago. The creator of this exhibition, Mr. E. J. Auston, has been identified for many years with nearly all the principal cycloramas in America, including "The Battle of Gettysburg," "The Chicago Fire," "The Crucifix," etc.

Some Interesting Patents.

The budget of electrical patents issued on July 17 contains an unusual number granted to well-known inventors. The activity in this direction is gratifying, and brings to mind the early days of electrical development.

Prof. Elihu Thomson is represented by a patent for a commutator, in which ready means are provided for renewing the insulation between the

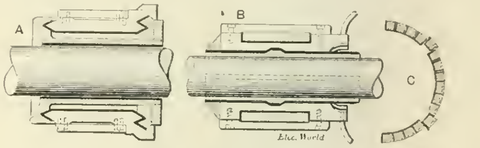


Fig. 1.—Renewable Commutator.

segments or of correcting the defects in the face of the commutator by removing a few of its segments without turning down the whole commutator. To this end the commutator is divided into a set of sub-segments and a set of wearing or surface segments, upon which the brushes bear and which are insulated from one another. In Fig. 1, A and B show two forms of commutators, the segments in the second case being secured by a binding wire. The manner in which the insulation, which may be of mica or mica paper sheets, is applied is shown in C, the upper half representing all of the segments with insulating material, while in the lower half each alternate segment would be directly attached by screws to the sub-segment without insulation underneath.

A system of electric distribution forms the subject of a patent issued to Prof. Edwin J. Houston, the application for which was filed November 17, 1887. The object of the invention is to enable electric currents of low E. M. F. to be readily converted into currents of high E. M. F., thus extending the application of those sources of electrical energy which are limited to the generation of low E. M. Fs. The current from a unipolar dynamo electric machine, thermo electric pile, combustion carbon battery, or other source capable of generating electric currents of great quantity but low E. M. F., is passed through the primary of an induction coil of any of the well known forms. This current is caused to vary in intensity or direction by any of the well known methods, such as are employed in connection with induction coils, so as to develop secondary currents of higher E. M. F. in the secondary coils. At the same time the secondary coils of the induction apparatus are provided with a suitable commutator acting in unison with the devices providing changes in the direction or intensity of the primary current, so as to commute or

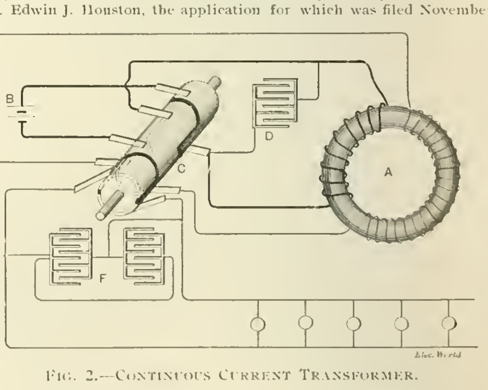
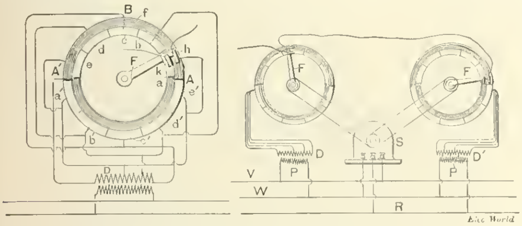


Fig. 2.—Continuous Current Transformer.

turn into one and the same direction the high potential alternating currents developed in the induction apparatus. Referring to Fig. 2, A is an induction coil and B is an electric source of low E. M. F.; C is a commutator of any construction suitable for varying, interrupting, changing or reversing the currents from the source B, the source B is placed in a circuit whose terminals are provided with brushes resting on the commutator, as shown, the primary of the induction coil being similarly provided. In order to commute the alternating current thus formed there is in the secondary circuit of the induction coil a third set of brushes, while a fourth set transfers the current to the working circuit. Condensers D and F may be used in the primary and secondary circuits so as to secure greater uniformity in the current.

A patent granted to John F. Kelly, of the Stanley Laboratory Company, relates to a method and apparatus for transforming alternating into continuous currents, and is based upon the fact that if two alternating E. M. Fs. in quadrature be made to vary respectively as the sine squares and the cosine squares of the angle traversed, their sum will always be constant, and therefore produce a undirectional constant current.

If the conductor, D, Fig. 3, in the form of a coil, such as the secondary of a transformer, be divided up into a certain number of sections of proper lengths and a brush caused to travel at a uniform rate in contact



FIGS. 3 AND 4.—APPARATUS FOR TRANSFORMING ALTERNATING INTO CONTINUOUS CURRENTS.

with the terminals of such sections, it is evident that the proportionate part of such conductor included between such brush and a stationary brush connected with one end of the conductor will depend upon the relative lengths of the sections. These sections are proportioned in the following manner: Suppose that there are M sections in the conductor, and that the whole number of turns or length of the conductor, which we will represent by L, be taken as corresponding to the sin $\frac{1}{2}\pi$ or ninety degrees, then the number of turns included in the first section beginning with the largest will be sin $\frac{\pi}{2M}L$ the number included in the first two sections, sin $\frac{2\pi}{2M}L$, in the first three sin $\frac{3\pi}{2M}L$, and so on up to $M-1$ sections, sin $\frac{(M-1)\pi}{2M}L$.

A series of insulated contact plates is provided which are designated by the letters a, b, c, d, e and a', b', c', d', e', and a continuous plate f so arranged that two brushes, h, k, making one complete revolution in the time occupied by a complete cycle of the current to be transformed, may be caused to sweep over them, the disposition of the plates being such that during one-half of the cycle of movement one brush, as h, will remain in contact with f, while brush k passes successively over plates a, b, c, d, e, and during the remaining time the brush k remains in contact with f while brush h passes successively over plates a', b', c', d', e'.

One terminal of the conductor D is connected with plate f and the terminals of the several sections are connected in order to plates a, b, and c. If, therefore, the brush k be caused to traverse in succession the contacts a, b, c in a quarter period, brush h meanwhile remaining on plate f, all of the conductor, D, will have been traversed in that time, the number of turns included in the circuit varying as above described so that the electromotive force between the brushes h and k will be equal, at any instant, to $E \sin^2 2\pi n t$. If the brushes be then moved back the sections of conductor, D, will cut out in reverse order; but this is more readily accomplished by causing the brushes to continue their motion so that brush k passes over plates c, d, e, while brush h remains on plate f, said plates d and e being connected with the sections of D but in the opposite order to a and b, so that a forward motion of brush k from c to e is equivalent to a backward motion from c to a. The two brushes being carried around together, one in contact with the continuous plate f, pass from the point A, when they include no section to B, where they include all the sections of conductor D, and hence to A', where they again include no section.

At A' the continuous plate and the sections change places with reference to the brushes, so that the brushes in traveling onward reverse the connections of the conductor with respect to the external circuit.

The order of the plates a', b', c' is also reversed again in the third quadrant so that the last section of D cut out in the second quadrant is the first brought in in the third, and it will be understood that the plates in the third quadrant are connected in the same order as those in the first, while those in the fourth quadrant are connected in the same order as those in the second.

As the pair of brushes are rotated synchronously with the impressed frequency, they will include between them a number of turns substantially proportioned to the sine of the angle of rotation, and as the electromotive force at the terminals of the conductor D is also varying as the sine of the same angle, the electromotive force between the brushes will be substantially proportional to the square of the sine.

A similar conductor, D', Fig. 4, and a commutator such as described, but with the phase of the electromotive force shifted ninety degrees, will give an electromotive force substantially proportional to the square of the cosine, and if we connect the two sets of brushes so as to superimpose the two electromotive forces their sum will be constant. This is illustrated in Fig. 4, where V, W, indicate the leads from a source of two alternating currents in quadrature and R the common return. P and P' are the primaries of transformers included in the two circuits respectively and D, D' the secondaries, connected with the commutators as above described. A small synchronous motor S for rotating the brushes is indicated.

A thermostatic alarm is the subject of a patent granted to Charles Cuttriss, whose principle of operation is dependent upon the expansion in a drum of a medium such as a cut, in which provision is made for a slow escape or influx of the medium. These conditions being secured, any expansion of the confined air, which increases its volume more rapidly than the leakage can compensate for, will result in the operation of the device, without regard to the actual degree of temperature from which the rise took place. In Fig. 5 A represents an ordinary sheet metal drum or case with deep circumferential corrugations, closed at the top by a metal plate or head, B, in which is set in an insulating bushing an adjustable contact screw. Beneath the screw and solder or fixed to the bottom of the device is a conducting pin or stud, E. A circuit is made from the metal case to the insulated screw, and includes a battery, F, and the magnet, G, of a relay controlling the circuit of a battery, K, containing an alarm bell. In the head, B, is inserted a small body of porous material, H, such as a section of the unglazed earthenware used for battery jars, or in any other way provide a leak, or retarded passage for a slow escape and influx

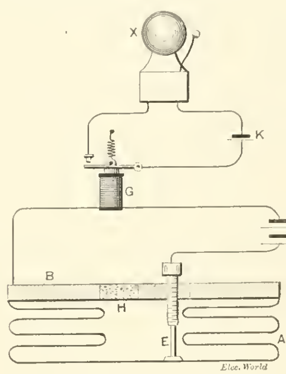


FIG. 5.—THERMOSTATIC ALARM.

of the air or other medium within the device. In practice the leak or breathing hole, as it may be termed, is adjusted so that a variation of temperature of 1° a minute will not produce a separation of the points of contact. Such a variation, while hardly possible from natural causes, might reasonably be expected to be exceeded by almost any fire that would be likely to occur in the neighborhood of a thermostat. Any source of artificial heat, therefore, that would cause a rise of temperature around such a thermostat, at a rate greater than 1° a minute, would produce an expansion of air within the instrument and sound the alarm by producing an elongation of the case.

An important series, three in number, of patents, to which we will refer in a following issue, relate to the Johnson-Lundell electric street railway system, a general description of which appeared in The Electrical World of May 12.

The Lewis Train Electric Lighting System.

In a paper read at the annual meeting of the Association of Railway Telegraph Superintendents, in Detroit, last month, Mr. M. B. Leonard, Supt. Tel. C. & O. Railway, read an interesting paper on the electric lighting of railway trains, from which we abstract the following description of the Lewis system, to which the greater part of the paper is devoted, and which receives high praise from Mr. Leonard.

This system, of which an account of its application to electric lighting from windmills appeared in our issue of February 3, 1894, is the invention of Lieut. I. N. Lewis, U. S. A., and consists of a dynamo fixed on the car truck itself and flexibly belted to the car axle, which charges a storage battery of 12 cells carried under the car and at the same time, if necessary, supplies current for lamps in the car. The illustration shows the details of the connection between the dynamo and the car axle, and also the arrangement of the various circuits. The Lewis dynamo

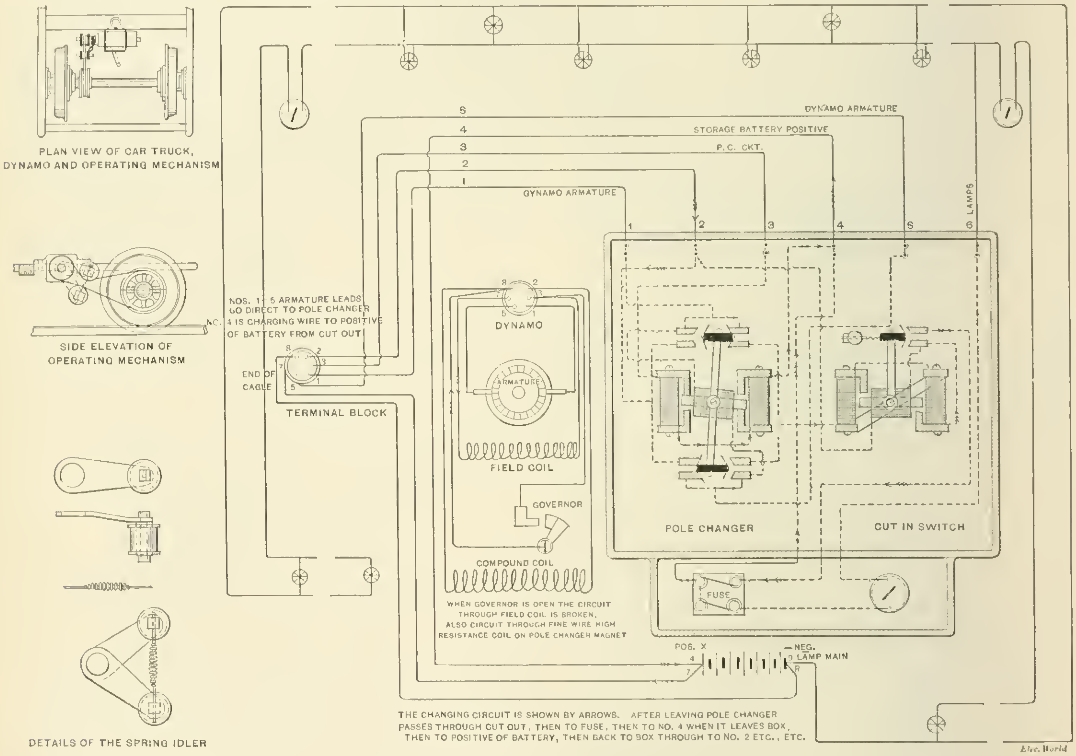
employed is one having a maximum output of 25 volts and 50 amperes. Rectangular carbon brushes are used, which are fixed in position. The machine is iron clad, being fitted with a close iron cover protecting the commutator, fields and the brushes. Graphite bearings are used for the armature shaft and do away with the use of oil. The frame is bolted to the bolster or truck beam, and connected by a rawhide belt three inches wide to a 20-inch pulley on the axle, the armature shaft carrying a 7¾ inch pulley. The distance between pulley centres being small, the belt is kept tight on the armature pulley by a pair of spring idlers, consisting of two flanged pulleys 4½ inches in diameter, over which the belt runs, revolving in graphite bearings and held together by the spiral spring on each side with adjustable nuts.

The distinguishing feature of this system is the way the dynamo is wound, through which it is made self-regulating for all speeds and gives a nearly constant potential at the battery terminals without employing any of the auxiliary regulating devices heretofore necessary in axle-driven dynamos to obtain this constant E. M. F. at varying speeds of the train. This regulation Lieut. Lewis accomplishes by a reverse winding of the series coil, the current passing through this coil going in an opposite direction to that in the shunt; the latter is fed from the storage battery, position the lever would thus be forced to take, it would, by means of the brushes on its end, reverse the relation between the armature and storage battery poles, thus sending the current through the battery in the same direction as before.

The cut-out switch consists of a pivoted electromagnet connected to the storage battery circuit, facing another electromagnet through which the armature current flows. When the current in the latter attains a certain strength, the lever magnet is attracted against the face of a spring, thus making the charging current, which is broken when the current falls below the specified amount or is reversed.

The accompanying diagram, which shows the wiring of the car on Mr. Leonard's road, illustrates the several features above described. The battery in this case will furnish about eight hours' lighting when the car is stationary.

The storage batteries which according to Mr. Leonard have been the most satisfactory are the chloride accumulators. The batteries are carried in a box under the car out of the way, which is pierced with holes to allow the gas evolved in charging to escape. With four or more cars they are fitted with a special form of switch which opens the charging circuit automatically whenever the battery is fully charged, thus preventing



Train Electric Lighting System.

and its circuit automatically opened by a switch on the end of the armature shaft in order to prevent waste of the battery current when the car is standing still. By this means the E. M. F. does not vary more than a few volts, notwithstanding large variations in the speed of the train.

Next to the dynamo the important features of the system are the pole changer and automatic cut-out. The former insures that the charging current is always of the same polarity, and the latter cuts out or cuts in the storage battery when the dynamo voltage falls below, or when it attains a specified amount, thus preventing the battery from discharging through the dynamo in the former case. Both of these are placed in a small box with a glass face which may be put up anywhere in the car, as no attention is required.

The pole changer consists of an electromagnet in the form of a vertically pivoted lever, with contact brushes on one end, and through whose coils the armature current passes. The lever is so arranged as to be controlled by two other electromagnets receiving their current from the storage battery. Should the direction of the car be reversed, the reversal of the armature current would follow, the polarity of the lever would be changed, and it would be repelled from the magnet which formerly attracted it and attracted by the one which before repelled it; in the new unnecessary drafts on the locomotive for power. As the apparatus does not operate until the train has attained a speed of about 20 miles an hour, no extra work is imposed on the locomotive in starting the train. The entire apparatus is entirely automatic in its operation, requiring no expert attention, except a periodical inspection at the terminal points, and has given excellent satisfaction on the C. & O. Railway as well as on the car that has been running for some time on the Brooklyn Bridge in New York, where another one is about to be installed. In regard to the dynamo-axle system employed, the Telegraph Superintendent of the London, Brighton & South Coast road, where it has been used for four years, states that there have been but two failures in that time; that the apparatus can be used for several weeks at a time without attention except lubrication, and at the end of this time only a readjustment of the commutator brushes is necessary to put the machine in condition for a like period. Mr. Leonard believes that there is no reason why the Lewis dynamo-axle system will not show as good a record as this, if not better, as no oil is required for lubrication and no adjustment of the carbon brushes is necessary.

The following is a synopsis of the cost with the different systems of train lighting referred to in the paper, in which, however, the average

cost given per car for the Pintsch does not include the proportional cost of generating and compressing apparatus.

System.	Avg. cost pr. car 16 c. p.	Avg. lamp pr. car.	Total illumination pr. car, candles	Cost pr. car day.	Cost pr. car hour, in cents.	Cost pr. lamp hour, in cents.
Com. dynamo and storage battery.	$968.00	22.5	360.	$1.99	19.90	.88
Silvey battery (C. & O. road).	709.00	9.3	148.8	0.944	9.44	.82
Storage battery (Pullman Co.	650.00	27.	432.	1.694	16.94	.70
Direct current. (C., M. & St. P.)	338.00	18.	288.	0.977	9.70	.54
Lewis—operated from car axle.	500.00	12.	192.	0.479	4.79	.39
Pintsch, gas	400.07		148.8	0.943	9.43	
Oil	72.00		148.8	0.636	6.36	

Single Post Elevated Railway.

The elevated railway system we illustrate, the invention of J. P. Hanlon, Boston, is intended especially for electric traction, though any motive power can be used. The weight of the car or cars can be sustained equally by the upper and lower rails or three-fourths carried by one and one-fourth by the other, any of which dispositions will prevent lateral oscillation or any undue divergence of the cars from their proper path of travel; hence by this system, it is claimed, a single post line for an elevated railway can be employed with the advantages of the least amount of friction, and safe, smooth and rapid transit.

Fig. 1 represents a side elevation of the superstructure and car placed between the rails, the lower rail being supported by a series of columns or posts arranged along the curbing of the sidewalks, or centrally of the street, as may be preferred, or as circumstances dictate; and the upper rail is supported by iron girders surrounding the car and resting on and supported by said columns or posts. Fig. 2 represents an end view of the superstructure and car between the rails with guard rails occupying a position on either side of the car hanger and about midway between the roof of the car and the upper rail.

In rounding or traversing curves, and to prevent any tendency of the cars from leaving the rails, there are provided guard rails arranged concentric with the upper rail line and supported by a series of oval iron girders. There are also two horizontally revolving anti-friction wheels, which are so located as to impinge against the guard rails when the car is traversing curves, and thus counteract any strain that may be brought on the upper and lower wheels and their connecting parts. The system is not confined to the particular disposition of the guard rails on curves alone, since they may be introduced continuously along the line, with equally good results. In traversing curves, it will be understood that each wheel of the upper and lower sets is not only journalled separately, but also capable of motion within a pivoted truck, as is the case in ordinary railway car trucks; hence it is obvious that each wheel will adjust itself to a curve of any radius, however small.

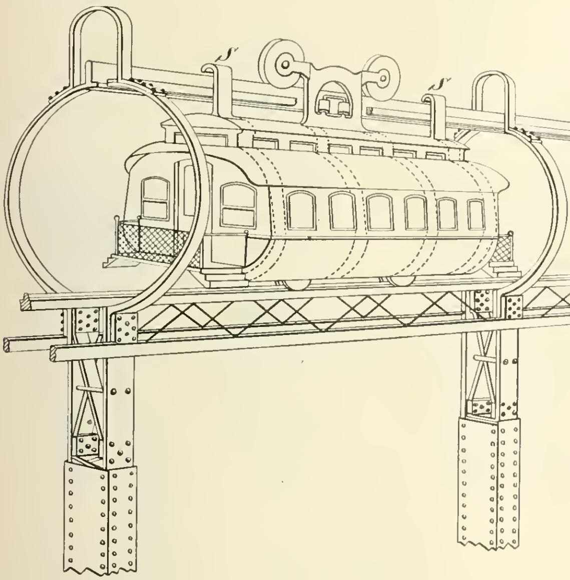
Fig. 1 also illustrates the position of two safety hangers marked S S, which are attached to the car for the purpose of holding and sustaining the car on the upper rail in case any or all the wheels should be broken or displaced.

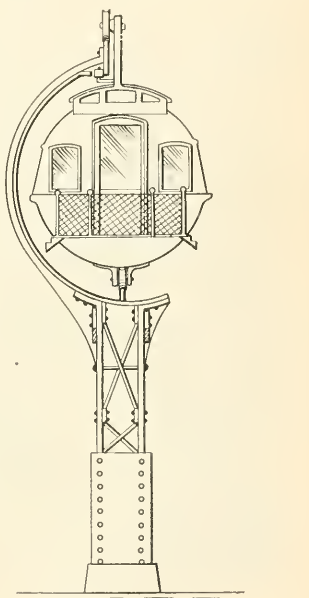
The length of the car, including platforms, is 50 feet; width of car, 6 feet, height, 8 feet. The seating capacity of each car is 70 passengers, and the carrying capacity 110 passengers. The weight, including wheels, motors and 60 passengers is about 9 tons.

The claims made for the system are as follows:

A perfect natural poise and adjustment of the cars upon the rails, rendering it possible to combine such ease and smoothness with the greatest rapidity of motion that the impression received by a passenger or spectator is that of a swiftly gliding motion; the peculiar construction of the superstructure, which offers the least possible obstruction to light and air; the mechanical impossibility of the cars leaving the rails, rendering an accident very improbable and almost impossible; the wheels being but few in number and natural in position, this system can be operated with one half the power required for any other system; while all other systems require a large section of the superstructure to be moved on a turn table to allow the cars to cross at right angles this system requires but a small portion of the upper rail only to be moved; in switching, all other systems require that a large section of the superstructure be moved, while in the Hanlon system switching is done by moving a small portion of the upper superstructure only, as the lower rail moves without interfering with the lower part of the superstructure.

This system of elevated railways has, we are informed, been critically examined by competent and impartial engineering and electrical experts, who have pronounced it entirely free from all the dangerous and other objectionable features of the systems that have been or are now being considered in the Massachusetts legislature in connection with Boston rapid transit projects. It is the intention of the syndicate having charge of this system to make application to the Massachusetts legislature for a charter to construct, equip and operate said system through Boston and its adjacent cities and towns.





Figs. 1 and 2.—The Hanlon Elevated Railway.

Direct Connected Multipolar Generators.

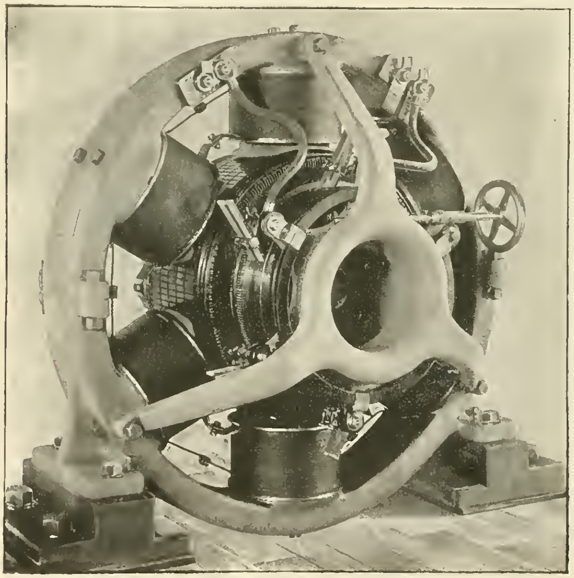
The new type of direct connected multipolar generators for lighting purposes which the General Electric Company has been manufacturing for some time past with signal success is herewith illustrated. It will be seen that a very large part of the material used is available for magnetic purposes. The magnetic circuits are shortened and a greater output with a higher efficiency can be obtained from a given weight and speed. Their shape in itself is an advantageous feature as it allows of a great saving in station space and consequent economy in real estate investment.

The frames and pole pieces are cast from a special soft steel of very high magnetic permeability, and the construction of the armatures is such that a constant current of air circulates through the core and windings and provides the necessary ventilation. The armature windings consist of straight copper bars so connected as to render short circuits or similar troubles practically impossible. The insulation is built up of

alternate laminations of tough paper and sheet mica, joining high spark-resisting qualities with great mechanical strength and durability. The machines are designed for very small rise in temperature at full load, the limit on the standard machines being only 40° C. above the surrounding air after a continuous run of ten hours, while in the dynamos constructed for the U. S. Government the limit is reduced to 28° centigrade.

The General Electric Company's multipolar generators are divided into two classes, the "smooth body" and the "iron clad," the distinction lying in the construction of the armatures, the field frame remaining the same, with, of course, the number of poles differing with the capacity of the generator. The smooth body armature is used for the larger and the iron clad for the smaller sizes. In the smooth body armature the bars are separated from each other, and the constant circulation of air and the large surface area render the armature remarkably cool running. The bars connecting the inner and outer winding form the commutator, and as they are an integral part of the winding, the extra resistance from connecting leads, contact surfaces, etc., an important consideration in large machines, is eliminated. Each of these armatures has practically two commutators, one on each side, so that when one has worn down the armature may be turned around and a new commutator be presented to the brushes which are all in view of the dynamo attendant from the floor of the engine room. These machines are sparkless.

The iron clad armature derives its name from the manner in which the core is slotted. When the conductors are placed in the slots they become practically embedded in the body, and thus the iron of the armature being brought closer to the pole pieces, the reluctance of the magnetic circuit is reduced and the capacity for a given weight increased. The copper when placed in these slots is not penetrated with magnetic lines, the total flux passing through the teeth. Large solid copper bars may be consequently used as conductors without loss from eddy currents, and the armature winding becomes an ideally simple mechanical structure. The ventilation, insulation and facility of repair are of similar excellence to those of the smooth body type. The commutators are bolted directly to the body, and a flexible strip connects the sections of the windings with the commutator bars. On the larger sizes the clamping ring holding the commutator bars is made in sections. This allows of all the bars to be held in place with rigidity, and in case of a cross, or burn out of insulation between the bars, only a comparatively small section of the commutator need be disturbed to remedy the defect. The brush holders are all mounted on a spider or rocker arm, and may be all moved simultaneously by means of hand wheels. The brushes are of woven metal gauze, and upon which form of brush the General Electric Company holds the fundamental patents.



DIRECT CONNECTED MULTIPOLAR GENERATOR.

These multipolar generators are made in sizes ranging from 25 kw. to 800 kw. and for speeds ranging from 300 revolutions in the smallest to 90 revolutions in the largest. They may be run at other speeds, giving of course a change from the normal voltage. At any speed the voltage of the generator may be raised 50 per cent. and lowered 10 per cent. from the normal value which corresponds to this speed without impairing the satisfactory operation of the machine.

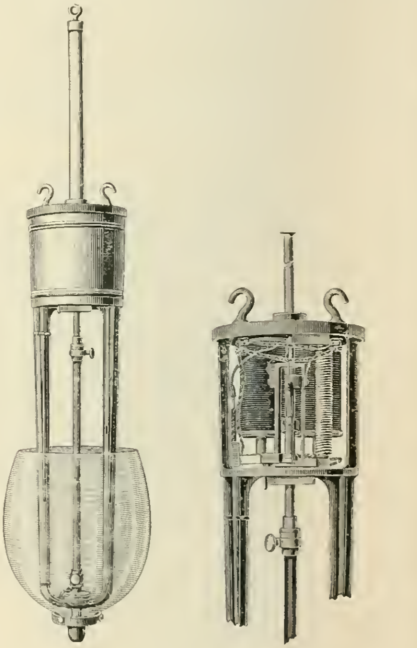
These machines may be connected directly to horizontal engines of the Corliss type or vertical engines of the marine type, triple or quadruple compound. The smaller sizes may also be connected to engines of the high speed type.

Improved Arc Lamp.

This lamp, shown in the accompanying illustrations, manufactured by Samuel W. Rushmore, 89 Liberty street, New York, is designed to meet the requirements of a simple and durable lamp for street lighting on the constant current or arc dynamos. Its chief claims for improvement over other forms lie in its extreme simplicity and solid construction, together with a most perfect clutch feed mechanism, that works perfectly even after very long use.

While the lamp contains a number of new features its most excellent ones are due to the careful design and the proper adaptation of devices that years of service have shown to be the best. The entire lamp frame is a single and very simple casting. The feed clutch is very simple, and the electrical control of the feed is so powerful that it is not at all necessary to have the clutch in the best condition for an even feed.

One of the greatest troubles with clutch lamps is the uneven wearing of the rod, and in this lamp the rod is made of phosphor bronze, insuring a much longer wear. The lamp has a positive cut-out that forms a part of the feeding mechanism and when the carbons are consumed the lamp is automatically short-circuited, in addition to the regular cut-out, so there is no chance of an open circuit on the line. This lamp is made to burn fourteen hours on any constant current circuit. It has a hand switch is entirely waterproof, and is neat in appearance for interior lighting.



ARC LAMP.

New Commutator Lubricating Compound.

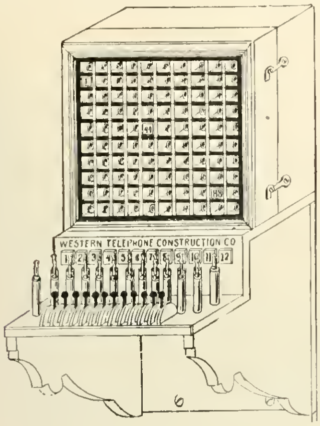
The Knott Manufacturing Company, 796 Seventh avenue, New York, has placed upon the market a commutator lubricating compound that is meeting with much success. It is compounded on new principles and is claimed to avoid the objections urged against similar articles in the past. It is made up only of vegetable substances and contains no vaseline, paraffine, beeswax or glycerine. It is easily applicable to all descriptions of commutators and is claimed to be a great economizer of brushes and commutators. A feature to be considered in the use of such compound is that the brush upon being removed does not require immersion in benzine or other cleansing material, as the compound volatilizes upon application and leaves on the commutator a highly polished and carbonized surface.

A Hopeless View of the Case.

"Improvements in primary batteries, while of considerable scientific interest, are of little or no commercial value."—London "Electrical Review."

New Telephone Switchboard.

We illustrate herewith a new switchboard for telephone exchange work now being manufactured by the Western Telephone Construction Company, of Chicago. The illustration shows a one-hundred subscriber exchange, which can be equipped either with metallic circuit or single wire. It is claimed for this board that it is the simplest switchboard yet



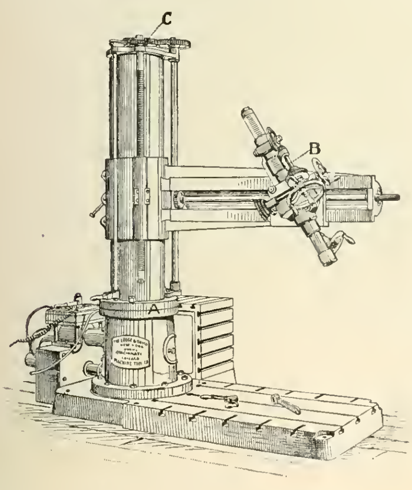
TELEPHONE SWITCHBOARD.

produced. Its compactness may be appreciated from the dimensions of the one-hundred subscriber board, which are 10 in. in width, 15 in. in length and 9 in. in depth, outside measurement, including cabinet. The operation is very simple. The electromagnetic armature is back of the jack, and the drop, or shutter, in front. The drop falls by gravity, and the same movement which inserts the plug into the jack restores the drop. It is also claimed for this exchange that it requires but one-third the service for the same number of subscribers as required by the most approved forms of board now in use. These switchboards are manufactured in all sizes up to one-thousand subscriber capacity.

Motor Driven Radial Drill.

The accompanying illustration is of a new half radial drill, built by the Lodge & Davis Machine Tool Company, of Cincinnati, O., and designed to be driven by a direct connected motor.

The motor is of the iron clad type, entirely covering the armature, pole



MOTOR DRIVEN RADIAL DRILL.

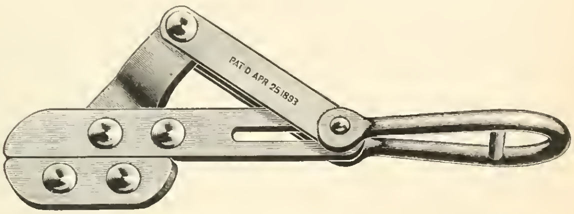
pieces and field coils, with commutator and brushes extending outside of the motor housing. It is free from external magnetism, which is necessary in order to keep small particles of steel and iron from adhering to the drill. The armature is mounted on a bronze spider, which is attached to the cone pulley.

The controlling lever is arranged on top of the motor, and by a semi-circular movement of same all forward and backward speeds may be instantly obtained. This, together with the back gears, at the rear of the swinging arm, gives not only a much wider range of speed than can be obtained by a cone pulley, but a much more finely graduated speed.

The column swings around an internal stump and rests at its lower flange, A, on balls to insure easy movement. The thrust on the elevating screw at C and the drill spindle at B is also taken up on ball bearings. The drill head is moved on the arm by a hand wheel, rack and spiral pinion, which is always within reach of the operator. The spindle is spring balanced, and fed by a rack and pinion in connection with the quick return, which can be instantly released, a valuable feature for tapping. The feed is obtained by pin gearing and can be changed while the drill is running.

The Buffalo Grip.

In the accompanying illustration is shown a simple but ingenious device for linemen, which has been found especially useful in telephone



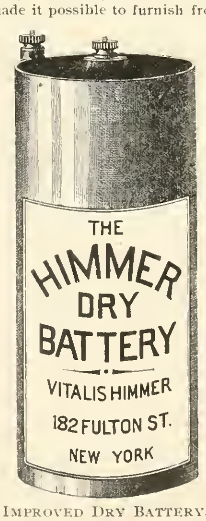
THE BUFFALO GRIP.

line construction. It has been styled the "Buffalo grip." The cut gives a very clear idea of its construction and its method of operation can readily be seen. This tool is sold exclusively by the Western Electric Company, of Chicago and New York.

A New Dry Battery.

Since its introduction the popularity of the dry battery has been constantly on the increase on account of its adaptability to places and purposes for which a liquid cell would be impracticable. The dry cell will stand much hard usage and still be ready for service when called upon. In the accompanying cut is shown a cell of the Himmer dry battery, manufactured by Vitalis Himmer, Sr., 182 Fulton street, New York.

A recent improvement, invented by Vitalis Himmer, Jr., and embodied in this battery, has made it possible to furnish from a single cell a dis-



IMPROVED DRY BATTERY.

charge of from 12 to 20 amperes at 1.5 to 1.8 volts and maintain it for a considerable length of time. The depolarizing properties of the battery are exceedingly good, recovering itself very quickly. This battery is particularly suited for cauterizing and other surgical purposes, as well as blasting and firing heavy guns, and should come into very general use for these purposes. In recent tests for the U. S. Navy, a battery of four cells gave 45 explosions per minute and reached 1,000 explosions before being exhausted. It is also being used for field telegraph and telephones, giving excellent service.

Financial Intelligence.

The Electrical Stock Market.

New York, July 21, 1894.

THE ELECTRICAL STOCK MARKET has shown evidences of new life. The whole financial situation has been immensely cleared of recent days, and were it not for the uncertainty in regard to the ultimate fate of the tariff bill, all business quarters would be sure to feel a new impetus. As it is what trading there is in the stock market is purely professional and the course of quotations reflects more the manipulation of the purely trading element than any specific development in business conditions.

GENERAL ELECTRIC'S course is a good indication of the effort to make quotations. Very little has been really doing in the stock, yet at times there is an appearance of strength and activity more apparent than real. There is a big pool at work trying to boost quotations, but, with trading everywhere restricted and with outside interest in the market conspicuous only by its absence, it is hard work to do anything more than to keep quotations steady. In their endeavor to put General Electric's price up a few points, the bulls on the property recite all kinds of favorable stories to warrant the stand they are taking. Efforts were made this week to revive the reports of a deal to equip the New York Elevated Railroad system with electric motors, but, as stated last week, while such a contract would be very pleasing to the General Electric people, the Manhattan Elevated Railroad Company has determined to await entering on negotiations to this end until the results of similar equipments on the two Chicago elevated lines are more fully established. An announcement of more definite value to General Electric stockholders is that the Metropolitan Traction Company has decided to experiment with an underground trolley system for surface lines, the patents of which are owned by the General Electric Company. If the system is found practicable, the Metropolitan Traction will equip all its new lines in this city with it.

WESTINGHOUSE ELECTRIC issues continue strong without being over active. There is a renewed disposition to buy the common stock in anticipation of the beginning of dividends at the time of the next quarterly distribution on the preferred stock; but the lifelessness characterizing the market prevents any decided trading. An officer of the Westinghouse Company is quoted as saying: "Business is keeping up better than was expected. The company expects to occupy its new shops at Brinton, near Pittsburg within the next 60 days."

THE STREET RAILWAY AND ILLUMINATING PROPERTIES demonstrated again this week the value of the bargain made with the General Electric Company by cancelling two more lots of preferred stock out of the proceeds of dividends and interest payments on treasury assets. On the 16th there were purchased 506 shares at an average price of $98.76 per share, as against $98.375 per share paid for 608 shares on July 11, and on the 20th inst. 505 more shares were bought at an average price of $99.10, making 13,561 shares purchased to date.

AMERICAN BELL TELEPHONE stock holds very strong; the firmness is remarked by interested traders, but no new developments have arisen to lend any peculiar significance to quotations.

WESTERN UNION TELEGRAPH is one of the strongest of the dividend-paying group of stocks. The recent rise is said to have been due not only to a continuance of the investment demand but to the operations of a small pool founded on the strength of the semi-official assurances that the earnings of the company were exceeding all expectations. In fact, it is understood that the revised statement of June will show a considerable increase over the preliminary estimate furnished at the quarterly meeting last month, while the receipts for July, despite the big railway strike, are said to be nearly equal to those for the corresponding period last year.

FT. WAYNE ELECTRIC stock continues strong on assurances that it will realize in liquidation nearer $5.00 than $4.00 per share. The Fort Wayne Electric Company is running its factory "in liquidation" and the new Fort Wayne Electric corporation is buying and reselling the output. A statement from the minority stockholders in defence of their action in wresting the control of the company from the General Electric is promised at an early date.

MEXICAN TELEPHONE stock has been weak a little on reports of aggressive competition in the City of Mexico, but the Boston officials of the company say that they know of no new concessions having been granted, and, as they have the exclusive right to use Bell and Blake telephone patents in Mexico, it is hard to see how any other company can occupy the field. The operations of the company for the three months ended May 31 last show net earnings of $13,495, an increase of $2,396 over a similar period in 1893.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric Co.	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
* Edison Electric Ill., New York	100	96	98
* " " " Brooklyn	100	100	102
" " " Boston	100	117	120
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com	15	15	17½
" " " " " pref.	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	36	36⅜
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref.	50	50½	51½
BONDS.			
Edison Electric Ill., New York	1,000	106½	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	194	194½
American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	—
Gold & Stock Telegraph	100	100	102
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	85¼	—

* Ex. div.

New Incorporations.

CITIZENS' TELEPHONE EXCHANGE COMPANY, Jersey City, N. J., capital stock $150,000, has been formed.

THE FIRE AND POLICE TELEGRAPH COMPANY, Louisville, Ky., has been incorporated, capital stock $50,000.

THE MANSFIELD TELEPHONE AND MESSAGE COMPANY, Mansfield, O., capital stock $50,000, has been incorporated.

THE GRAND RAPIDS MACHINE ELECTRIC COMPANY, Grand Rapids, Mich., capital stock $10,000, has been formed.

THE DELAWARE VALLEY ELECTRIC RAILWAY COMPANY, Philadelphia, Pa., capital stock $1,000,000, has been formed.

THE PNEUMATIC FIRE ALARM TELEGRAPH COMPANY OF NEW YORK, Jersey City, N. J., capital stock $250,000, has been formed.

THE MUSICAL TELEPHONE COMPANY, Saco, Me., capital stock $100,000, has been formed to manufacture and deal in telephones, etc.

THE DEFIANCE LIGHT AND RAILWAY COMPANY, Defiance, O., capital stock $100,000, has been formed to supply electricity and gas.

THE MURPHY POWER COMPANY, Chicago, Ill., capital stock $3,000, has been formed to generate electricity for light, heat and power.

THE CO-OPERATIVE HEAT, LIGHT AND POWER COMPANY, Sioux Falls, S. D., capital stock $50,000, has been formed to generate gas, etc.

THE NASCENT EXTRACTION METAL COMPANY, Denver, Col., capital stock $100,000, has been formed to extract metals from earth by electricity.

THE DULUTH-SUPERIOR TRACTION COMPANY, Elizabeth, N. J., capital stock $2,000,000, has been formed for the purpose of operating street railways.

THE UNITED ELECTRIC CORPORATION, Minneapolis, Minn., capital stock $10,000, has been incorporated to manufacture electrical apparatus and to operate lighting, power and railway plants.

THE FARIES MANUFACTURING COMPANY, Decatur, Ill., capital stock $50,000, has been formed to manufacture electric light holders, etc, etc. Robt. Faries, Wm. E. Surface and E. P. Irving are the promoters.

THE ELDRED ELECTRICAL MANUFACTURING COMPANY, Eldred, N. Y., capital stock $10,000, has been formed to manufacture and sell electrical appliances, engines, boilers and machinery. W. C. Ranney, L. B. Doman and A. E. Doman are interested.

THE KEYSER ELECTRIC LIGHT COMPANY, Keyser, W. Va., maximum capital stock $50,000, has been formed to produce and distribute electricity for lighting, etc. F. M. Reynolds, J. M. Templeton and Andrew Keenan, all of Keyser, are the promoters.

THE SEATTLE HOME TELEPHONE COMPANY, Seattle, Wash., capital stock $100,000, has been formed to do a telephone, telegraph and general electrical business. J. H. McGraw, J. D. Lowman, A. B. Stewart, A. M. Brooks and George F. Gund, all of Seattle, are interested.

THE FIRE ALARM CONSTRUCTION COMPANY, New York, maximum capital stock $1,000,000, has been formed to construct, acquire and operate systems of electric and other fire alarms, etc. Leopold Wallach, Henry M. Cross and Maurice Maas, all of New York, are the promoters.

THE CINCINNATI ELECTRIC SERVICE COMPANY, Cincinnati, O., capital stock $10,000, has been formed to build and operate electric lines for telephonic communication and for other electrical service. M. T. Corcoran, Wm. Cullen, J. F. Dougherty, E. D. Whitehead and P. J. Corcoran are the incorporators.

THE OSWEGATCHIE LIGHT AND POWER COMPANY, Gouverneur, N. Y., capital stock $60,000, has been incorporated by H. Walter Webb, A. G. Payne, Wm. J. Arkell, A. L. McCrea, Jr., and A. J. McDonald to furnish electricity and gas to Gouverneur, Edwards, Fowler and other towns in St. Lawrence County.

THE UNITED STATES ELECTRIC FORGING COMPANY, New York, maximum capital stock $1,000,000, has been organized to buy and sell electrical apparatus for heating, forging, welding and otherwise treating metals. E. Garcia, New York, A. C. Garcia, Arlington, N. J., and B. J. Fredericks, New York, are the incorporators.

ELIZABETH, N. J.—The Duluth & Superior Traction Company has been incorporated. The capital is placed at $2,000,000. It will engage in the business of constructing and operating electrical street railways in the cities of Duluth, Minn., and Superior, Wis. The incorporators are Edward V. Douglas, of Philadelphia, John H. Davis, of New York, and Frank Bergen, of Elizabeth.

THE GREAT KANAWHA FALLS, WATER POWER, ELECTRICAL MANUFACTURING AND LAND COMPANY, Charleston, W. Va., maximum capital stock $2,000,000, has been incorporated to utilize the water power of the Great Kanawha Falls and River for the production and transmission of electric power, etc. O. A. Patten, W. W. Tompkins and W. D. Scott, all of Charleston, are interested.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, July 23, 1894.

THE BOARD OF ESTIMATE AND APPROPRIATION, of Brooklyn, has authorized the issue of $15,000 for the erection of new buildings for the fire department, and for conduits for the fire alarm.

THE NASSAU ELECTRIC COMPANY, of Brooklyn, has begun to cart its ties and rails on Rockaway avenue, and work will be speedily pushed on the new railroad from Canarsie Shore to Brooklyn.

HIGHWAY COMMISSIONER HORTON has given consent to the Coney Island, Fort Hamilton & Brooklyn Railroad to construct and operate a railroad by either horse or electric power in the various streets of New Utrecht.

THE COMMERCIAL CABLE COMPANY, 253 Broadway, announces that its new and third Atlantic cable is completed and in working order. This is the tenth year of the company's existence, and it maintains its reputation for speed, accuracy and reliability.

MR. ADOLPH LAMBERT, travelling salesman, representing the Infinity Manufacturing Company, New York city, manufacturers of dry batteries, is meeting with marked success during his Western trip the past two weeks, having taken some very large orders.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, the present agent for New York and vicinity of the Buckeye Electric Company, has just been appointed the exclusive agent of that company for Massachusetts, Rhode Island and Connecticut, in addition to the territory already covered by them. The Buckeye Electric Company has placed its interests in good hands.

VITALIS HIMMER, SR., has resigned his position as general manager of the Himmer & Anderson Dry Battery Company and opened a factory of his own at 182 Fulton street, New York. Having been for the past twenty-six years engaged in the manufacture of electric clocks and the various kinds of batteries, being the introducer of the Gastner dry battery, he is well qualified to conduct the business and produce a battery equal to the best. His son, Vitalis Himmer, Jr., has recently brought out a valuable improvement in dry batteries described elsewhere in these columns.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 21, 1894.

THE HARRISON SAFETY BOILER WORKS have established an Eastern branch office under the management of Mr. Sumner B. Merrick, at No. 19 Pearl street, Boston, Mass., who will give his personal attention to their interests throughout the New England States.

GREENFIELD, N. H.—The town of Conway has voted to raise $5,000 toward the stock of the electric road from Conway to the depot. The road is primarily for freight, but passengers will also be carried. Work will be begun at once. The balance of capital, $20,000, has been raised by private subscription.

LAWRENCE, MASS.—The new extension of the Lowell, Lawrence & Haverhill Street Railway to Glen Forest, Methuen, has been opened to the public. The line was christened by the annual excursion of the Merrimac River Boards of Trade on July 10. Messrs. Soule & Dillingham, the contractors, are receiving much praise for the excellent style of the equipment.

MAYOR MATTHEWS is determined to precipitate action with reference to burying wires within the corporate limits of the municipality in accordance with the law enacted by the last Legislature. The nomination of Hon. John R. Murphy as Commissioner of Wires under the law was made by the mayor in order to hasten work, for it is the purpose of the latter to have matters in such shape that preparatory work will have been finished in season to permit corporations to place their wires beneath street surfaces early this Fall.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, July 11, 1894.

THE FAURE PATENT.—The owners of the Faure patent in this country are petitioning the Privy Council for an extension thereof.

A DAVY-FARADAY RESEARCH LABORATORY.—Mr. Ludwig Mond, of the well-known firm of chemical manufacturers, Brunner, Mond & Co., has just made a munificent gift to the Royal Institution. He has purchased the large house adjacent to the Institution, and proposes to erect therein a laboratory to be called the Davy-Faraday Research Laboratory, which he also proposes to equip and endow in a manner in consonance with the demands of modern science, for the purpose of enabling research work in "physical chemistry" to be carried on.

ELECTRIC RAILWAY ENTERPRISE IN LONDON.—As I wrote to you some time ago the onerous terms in connection with the running of workmen's trains, which the London County Council sought to impose upon the promoters of the proposed electric railway which was to run from the city to Epping Forest, caused the promoters of the scheme to withdraw it. The withdrawal showed the London County Council pretty plainly that the promoters were in earnest when they said capital could not be raised under the conditions proposed, and the result has been that the County Council reopened negotiations with the promoters of the bill, and a compromise has been arrived at which will result in the bill going forward during the present session of Parliament.

A PRACTICAL UTILIZATION OF CATHODE RAYS.—The curious rays emanating from the cathode of a discharge tube, which as Dr. Phillip Lenard has recently shown are both photographically active and magnetically susceptible, have not had long to wait before a more or less practical application has been made of their properties. In a recent communication to the Academie des Sciences, M. Albert Hess proposed to let a cathode beam fall upon a rapidly moving photographic film, and to expose the beam en route to the action of a rapidly varying magnetic field or fields. If this suggestion prove really practicable, it would enable us to obtain a sort of inertialess Ewing curve tracer. The Ewing curve tracer has hitherto been limited, owing to its inertia, to a frequency of about 20.

THE GOVERNMENT AND THE TELEPHONES.—The public pronouncements and general attitude of the Post-Office towards the National Telephone Company have all along been of a very ambiguous character, and it is some satisfaction that an importunate member of Parliament at last should have succeeded in drawing something really definite from the Postmaster General. There is, I believe, some slight doubt as to the terms upon which the Post Office will be able to purchase the telephonic plant of the National Telephone Company, when its license expires in 1911, but, according to the Post Office reading of the license, the right of the National Telephone Company to carry on telephone exchange business will absolutely cease and determine in December, 1911, and all they will have to sell will be their plant, and even this the Government will be under no obligation to buy.

News of the Week.

TELEGRAPH AND TELEPHONE.

MEMPHIS, TENN.—The Novelty and Electric Company, it is reported, has assigned.

SALISBURY, N. C.—J. Allen Brown and E. B. Neave have secured a franchise for constructing a telephone system, and are now in the market for the necessary equipment.

PHŒNIXVILLE, PA.—The Police Department has concluded to put in a private telephone service, but has not yet decided upon the system it will use. Communications may be addressed to the superintendent of police.

ELECTRIC LIGHT AND POWER.

ST. GEORGE, N. B.—The people are agitating for electric lighting.

LONGUEUIL, CAN.—An electric light system is to be established here.

GUTHRIE, OKLA.—It has been ordered that electric lights be placed in the new county hall.

BARABOO, WIS.—The Common Council of Baraboo is considering the introduction of arc lights.

RICHMOND, IND.—Address Wm. S. Kaufman regarding purchase of electric lighting outfit, bells, etc.

INDIANAPOLIS, IND.—Address R. P. Daggett & Co., 28 Marion Building, concerning electric lighting outfit to be bought.

MEMPHIS, TENN.—Johnson, Carruthers & Rand Co. may be addressed concerning a 20-h. p. electric motor about to be purchased.

SPOKANE, WASH.—William Moore, city clerk, may be written to as to the cost of furnishing that city with lights for street illumination.

PHILADELPHIA, PA.—The Yearsley-Harris Electric Company has changed its title to the Harris Electric Company, Thomas Yearsley having retired.

HOPKINTON, IA.—Hopkinton has decided to have electric lights, and will grant an exclusive franchise to maintain an electric light plant there for a term of 20 years.

FLORENCE, S. C.—Address W. E. Sudlow & Co. regarding electric supplies wanted. Prices are desired on transformers 10s, 20s or 30s, or about 200 incandescent lights.

READING, PA.—The City Council is considering the advisability of the city owning its own electric light plant, and has instructed the city clerk to inquire as to cost of same.

BOSTON, MASS.—Boston is to have another new theatre on the site of the old Arena at Ferdinand and Isabella streets, South End. The theatre will have its own electrical plant.

MASSILLON, O.—Sealed proposals will be received until August 9 for the erection of a power house for the Massillon State Hospital. Yost & Packard, Massillon, O., are the architects.

GOODLAND, IND.—The Goodland Herald is publishing an advertisement for sealed proposals for an electric light plant at Goodland of 35 arcs and 1,000 incandescent capacity. The bid is to be opened July 25.

PITTSBURG, KAN.—A charter was granted to the Pittsburg & Frontenac Suburban Electric Railway Company. Capital $75,000. Samuel Barrett and A. L. Chaplin, of Pittsburg, and Carl J. Simons, of Chetopa.

SPOKANE, WASH.—The Centennial Company's Cereal Factory is being improved. The mill owns 250 h. p., and is only using 140. To make use of the wasted power a complete electric light plant will be put in.

NEW YORK CITY, N. Y.—Architect James Ireland has drawn plans for a new one-story brick electric light station, 22x57, at Nos. 204 and 206 Elizabeth street, to be built by the Brush Electrical and Illuminating Company.

WAUSAW, WIS.—At a meeting of the Council the special committee appointed to ascertain the cost of an electric light plant reported that a plant could be put in at a cost not to exceed $17,000. No definite action was taken by the Council.

ARCADIA, WIS.—At a meeting of the City Council it was decided to do away with kerosene lamps and use electricity exclusively. Arcadia has had an electric plant for some time, but it has been used only for lighting the business houses.

BAYONNE, N. J.—The new electric light company, in whose behalf a petition for a franchise was presented to the Council, is composed solely of Bayonne stockholders—Messrs. Geo. Carragan, Edward F. White, J. S. Packart and Dr. Samuel Myers.

NORWALK, CONN.—The Norwalk and South Norwalk Electric Light Company has had a receiver appointed in the person of L. C. Whitney on a petition brought by the first mortgage holders. Mr. Whitney is superintendent of the New Britain Electric Light Company and has filed bonds for $20,000.

MANITOU SPRINGS, COL.—C. W. Barker, of the Barker House, is interested in the project of establishing a $600,000 sanitarium to be lighted from the company's own electric plant. Electricity will be used in every way as far as possible. F. Baer, of Philadelphia, is also interested.

FREDONIA, N. Y.—Robert S. Bishop, president of American District Steam Company—Holly undergound system—is here looking over the plans of the Electric Heat and Power Company, which proposes to put in the Holly heating system in Fredonia, as well as an incandescent light plant.

WASHINGTON, D. C.—The syndicate of local and foreign capitalists, which recently bought the major part of the "low grounds," and all of High Island, intend to invest about $750,000 in the plant of the scheme and manufacture enough electricity to supply the entire city with light and power.

TORONTO, ONT.—It was decided to call for tenders for lighting the city on the same conditions as at present, the tenders to be in by August 1. When these

tenders are in the committee will consider whether the figures offered are such as to make it advisable to have the lighting done by a private company.

TOMAHAWK, WIS.—Mr. Bradley will soon commence the erection of a building at the rear of Library Hall to be used as a power house to furnish electric light and steam heat for the Mitchell House, the Irvington Stables, Library Hall and the Tomahawk office. Address W. H. Bradley, president Tomahawk Hotel Company.

SEATTLE, WASH.—A resolution was passed relative to the city lighting, directing the city engineer and city electrician to submit to the City Council on or before July 15 a plan for the lighting of the streets. At present there are many duplicate arc and incandescent lights, and the present contract with the company expires October 1.

ONTARIO, CANADA.—Address City Engineer E. H. Keating concerning a proposed municipal electric lighting system requiring a plant for 1,500 lights of 2,000 candle-power each, to cost $310,000 and to be operated at an expense of $106,000, the lamps burning all of every night, or equivalent to $82 per year per lamp, against $109 now paid to private parties.

SPOKANE, WASH.—Sealed proposals will be received until August 8 for furnishing the city of Spokane with light for its streets and public places. Bidders will be required to state the price per lamp per month, and candle power. All lights must be furnished on what is known as the all-night schedule on each and every night of the year. William Morse is city clerk.

ACKLEY, IA.—H. D. Bruening, who has managed the Eldora Electric Light plant since the start, has severed his connection with the company, and will unite with his brother, D. S. Bruening, of Ackley, and start an electric light plant at that place. The machine shops of S. D. Bruening will be fitted with dynamos, etc., and a three-wire Edison system will be put in in a short time.

NEWARK, N. J.—Sealed proposals will be received until July 31 for plumbing, gas fitting, piping and electric wire conduits for the United States Custom House and Postoffice Building at Newark, N. J., in accordance with drawings and specifications. Each bid must be accompanied by a certified check in a sum not less than two per cent. of the amount of same. Address Jeremiah O'Rourke, Supervising Architect.

The Electric Railway.

WILLIAMSBURG, VA.—Address the Mayor regarding the proposition to construct an electric railway.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway is placed on record as having appointed a receiver.

COLUMBUS, GA.—The North Highlands Railroad Company has been granted a franchise for operating an electric railway.

SAUNDERSVILLE, GA.—J. N. Gimore may be addressed as to the proposed electric railway from Saundersville to Tennile.

WESTMINSTER, MD.—The Baltimore Traction Company will extend its line from Baltimore to Westminster and to Washington.

HAZEL HILL, N. S.—A project is on foot to run an electric railway from Hazel Hill to Canso, N. S., a distance of three miles.

PORTLAND, IND.—A franchise has been granted for an electric railway between Red Key and Dunkirk, and for lighting both with electricity.

WILLIAMSBURGH, VA.—The formation of a stock company to build an electric railway to King's Mill Wharf is in contemplation.

RUTHERFORD, N. C.—Address Jonah White concerning a proposed electric railway to be built from Rutherfordton to Chimney Rock, a distance of 17 miles.

TURTLE CREEK, PA.—The Turtle Creek Valley Electric Railway Company proposes to extend its line through Braddock, Turtle Creek, Wilmerding, and out to Irwin.

SYRACUSE, N. Y.—The Syracuse, Eastwood Heights & DeWitt Railroad Company will complete the railroad which is partially constructed between this city and East Syracuse.

SAGINAW, MICH.—An ordinance giving the River Park Railway the right of way to construct and operate an electric street railway on certain streets was passed with objection.

CANANDAIGUA, N. Y.—M. Dwight Munger, of the Canandaigua Electric Light and Railway Company, has contracted to furnish electric lights for the village of Palmyra, N. Y., for ten years.

BALTIMORE, MD.—Address Thos. S. Hodgson, 6 East Lexington street, president Somerset Electric Light and Railway Company, concerning 2½ miles of electric railway, which is to be constructed.

CLEVELAND, O.—An ordinance has been passed granting the Cleveland Electric Railway right to extend and operate its double-track street railway in Quincy street from New street to Wilson avenue.

HOMER, N. Y.—A franchise having been granted to the Cortland & Homer Traction Company to run its cars through this village by electricity, the work of changing will begin as soon as possible.

KNOXVILLE, PA.—Knoxville Borough Council met and discussed the question of constructing a new electric line from that place to Mt. Lebanon and Castle Shannon. A special meeting will be held Wednesday next to act on the scheme.

BOSTON, MASS.—Four pieces of land on Eagle street, near Eagle Square, in East Boston, comprising in all 300,000 square feet of land, have been secured by the West End Street Railway Company for the site of the new power house for the electric railway system in East Boston.

MONTCLAIR, N. J.—Applications for franchises for electric street railways in Montclair over three designated courses were received from the North Jersey Street Railway Company and referred to a special committee, composed of Messrs. Thompson, Sawyer, Simms and English.

TORONTO, CANADA.—Messrs. Fraser, Morton and H. H. Dewart, solicitors, appeared before the York Township Council asking for the privilege of extending the City & Suburban Electric Railway from its present terminus at Toronto Junction along the Weston road south to the village of Weston.

LAUREL, MD.—At a meeting of the City Council this week a franchise was granted to Messrs. Phelps & Shaffer to build and operate a street railway, with either electric or horse power. The road is to be completed in two years. The probability is that the road will be operated by electricity, generated by water power.

DIXON, ILL.—The City Council has adopted an ordinance granting a franchise to the electric railway company for the laying and operating of a street car line through the city of Dixon. The system is to be a part of the Rock River Electric Railway from Rockford to this city, the right of way for which has already been secured.

READING, PA.—The Reading & Temple Electric Railroad Company has asked permission to extend its line, beginning at Front and Robeson streets, east on Robeson to Centre avenue, to Bern street, connecting at that point with the tracks of the Reading Passenger Railway Company on Centre avenue, and returning by the same route.

DOWNINGTOWN, PA.—A few days ago a group of Downingtown's most influential citizens were talking about the borough needing an electric railway. One of them said that he considered it would be a good investment for private capital to build an L road between this borough and West Chester, and he thought the road could be built for about $40,000 or $50,000.

M'KEESPORT, PA.—Attorney J. A. Henderson, Homer H. Sweeney, Jas. and Dr. Suckstager, all of McKeesport, have made application for a charter, granting them right of way over Youghiogheny River at foot of Fifth street, and also for the purpose of bridging the river and constructing an electric railway three miles long, costing $600,000, to connect Glassport with this place.

ALLEGHENY, PA.—Work on the survey for an electric railway, which will connect Pittsburg with Tarentum, Natrona, Springdale, Freeport and all the numerous intervening towns on the north side of the Allegheny River, was recently completed. The same company of Allegheny capitalists which owns a charter covering a proposed line to Butler by way of Etna and Glenshaw, is said to be interested in the Tarentum and Freeport line.

WASHINGTON, D. C.—In the House Mr. Baker introduced a bill authorizing the Rock Creek Railway to extend a single track from U Street down Seventeenth, to P, to Fifteenth Street, and from Florida Avenue down Eighteenth Street to R, to Fifteenth Street, to I, to Thirteenth, to B, to Seventh; also on U Street through Mt. Pleasant on or near Seventeenth Street, to Rock Creek and Zoological Park. Cable or electric power may be used.

DIXON, ILL.—The City Council has granted a franchise to the electric railway company for the laying and operating of a street car line through the city of Dixon. The system is to be a part of the Rock River Electric Railway from Rockford to this city. The right of way has already been secured. The franchise gives the company the right to use the wagon bridge over the Rock River.

YONKERS, N. Y.—The North and South Railway Company has been incorporated to construct a street surface road about five miles in length, in Yonkers, to run from the vicinity of Shonnard Place to the southern boundary of the city of Yonkers on South Broadway. The capital is $50,000, and the directors are William Delavan Baldwin, S. T. Hubbard, John C. Shotts and T. H. Silkman, of Yonkers, and others.

TRENTON, N. J.—The New York & Philadelphia Traction Company has been incorporated. The capitalization is $10,000,000. The incorporators are: Ex-Mayor Frank McGowan and James P. Durrah, of Trenton, and Jos. H. Reall, of Bloomfield. Associated with them are D. K. Bayne, of New York, and others. The company proposes to construct 150 miles of track in the State of New Jersey, and to connect New York with Philadelphia by a trolley road. The route will be through Newark, and thence by the most direct route to Trenton. Spurs will be built to connect the main line with Paterson, New Brunswick, Rahway, Elizabeth and other cities. The city has the right of way by two routes from this city to Philadelphia. One is down the east bank of the Delaware to Camden. The other is on the opposite bank.

Personal Notes.

MR. HENRY B. OAKMAN, as his many friends will be pleased to learn, has accepted the general Eastern agency of the Wenstrom Electric Company. Mr. Oakman is one of the youngest men in the electrical field, having been born in 1870 in Brooklyn. He received his early education in the common schools of that city, and at the age of 16 entered the electrical field by going with the Electric Supply Company, 17 Dey street, New York, as office boy. His energy and ability soon pushed him to the front and he rapidly rose to the position of salesman and afterwards of buyer. Before he was 18 he accepted a position with the Long Distance Telephone Company as special agent and remained with that company for one year. He then organized the Empire Safety Manufacturing Company, occupying the position of treasurer, a place which he held for about two years. In January, 1891, he accepted an offer from the Edison General Electric Company as city salesman, but in course of a few weeks was promoted to the position of State agent for Connecticut, with offices at New Haven. He remained here but a few months when he was sent to Buffalo by the Edison Company to select a site for a store and show rooms. Soon afterwards he was appointed general Western agent of the Edison Company for the State of New York. This place he filled most satisfactorily to the company, but on the consolidation of the Edison and Thomson-Houston companies he resigned, and believing in the future of the Wenstrom apparatus he accepted a position with the Wenstrom Electric Company. The result was that he has been appointed its general Eastern agent. He also found it advisable to incorporate a company to handle the specialties in which he has become interested, and accordingly the Oakman Electric Company has been incorporated with Mr. Oakman as treasurer.

H. B. OAKMAN.

Miscellaneous Notes.

CHESTER, PA.—Ground has been broken on the left of Science Hall at Swarthmore College for a new building, to be devoted to apparatus and lecture rooms for an electrical department.

THE S. E. TARIFF ASSOCIATION has, on the recommendation of its electrician, Mr. A. M. Schoen, decided to adopt the rules of the Underwriters' International Electric Association for the installation of electric apparatus. This should be gratifying news to the Southern electric workers.

AN EXPLANATION.—In this column of our issue of June 30 we printed a humorous account, clipped from a local paper, of the alleged result of connecting a trolley wire with a wire fence to keep out trespassing animals. We are informed that the article does an injustice to a very worthy man and we regret that it found a place in our columns.

MR. ALLEN RIPLEY FOOTE read a paper before the Northwestern Electrical Association at St. Paul on July 18, entitled "A Question of Public Policy: Shall Public Services be Rendered by Political or Private Monopolies." The argument is an examination of the article in the platform of the Knights of Labor calling for the Government control and operation of all means of transporting intelligence, passengers and freight. The general principle is laid down that non-competitive businesses should be owned and managed by private monopolies under properly guarded franchises and contracts, and a lengthy discussion defines the character of these limitations.

Trade and Industrial Notes.

T. W. NESS & CO., electrical supply dealers, Montreal, Can., have failed with liabilities of $40,000.

THE BALL ENGINE COMPANY, Erie, Pa., reports that its shop is rapidly filling up with work, and that it has received some very large orders during the past few days.

THE SOUTHERN ENGINEERING AND CONSTRUCTION COMPANY, Atlanta, Ga., of which E. W. Dutton is manager, has closed a contract with the Atlanta Cotton Mills for a complete light plant of 400 lights.

THE OHIO VALLEY ELECTRICAL ENGINEERING COMPANY, 84 Johnston Building, Cincinnati, O., has been employed to build a fire and police alarm system for the city of Clifton, one of Cincinnati's most beautiful suburbs.

SCRANTON, PA.—The Scranton Electric Construction Company has applied for a charter for the purpose of manufacturing and furnishing electric plants. Those who are interested are E. P. Sturges, F. E. Platt, O. S. Johnson and others.

THE HARRISON SAFETY BOILER COMPANY, Philadelphia, is building one 8-inch and four 12-inch Cochrane high pressure horizontal separators for use on the steam mains of the Philadelphia Electric Traction Company's Delaware avenue power house.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., has found a new field for its Packard-Mogul lamp in the special illumination of parks by street railway companies, as an attraction to increase their passenger traffic. The Mogul lamp is claimed to be particularly adapted for this class of work.

THE GENERAL ELECTRIC COMPANY in April, 1891, installed four 100 kw. multipolar direct-driven dynamos in its Schenectady shops. These have served as examples of the economy and ease of operation of this class of generator, and since then the company has sold nearly 30,000 kw., or about 40,000 h. p., of these machines.

BRADLEY & COMBS, 7 Stone street, Rochester, N. Y., have issued a descriptive pamphlet and price list of their universal telephone switch hook. This hook does not, it is claimed, infringe any Bell Telephone patent, and is compact, neat, universal in application and compulsory in operation, and is well made both electrically and mechanically.

MR. L. W. COLLINS will hereafter be associated in business with Mr. C. E. Lee, 65 Lees Building, 147-153 Fifth Avenue, Chicago, dealer in electrical specialties. Mr. Collins is too well and favorably known to need an introduction here. The new firm will continue with the class of goods which Mr. Lee has hitherto handled, adding occasionally other specialties of merit, according to the demands of the trade, but it is not the intention to carry so large a line but that the firm can feel confident at all times that each specialty is the best of its class.

ARMATURE WINDING.—We take pleasure in publishing the following extract from a contribution received from Mr. S. W. Rushmore, 126 Liberty street, New York, in reply to an item which appeared in these columns last week in regard to his system of armature winding. Mr. Rushmore says: "My winding, although resembling the method described by this party, is radically different, and the method described by them cannot be applied to the Edison armatures with success, and that method can be used only on plating dynamos of a few volts potential."

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, had an interesting experience in the great strike. They had on hand an order for a lot of railway material that was particularly wanted for the 4th of July, in order to enable the railroad manager to fulfill his contract to run a special excursion. The first blow of the strike was especially effective, and practically stopped the movement of all freight trains. The Metropolitan Company, by working hard, succeeded in loading the material on a special car and sending it out by express all right. It reached its destination on time, and the excursion was run as though there were no strike whatever.

THE POPPOWITSCH ELECTRIC COMPANY has purchased a tract of land in New Haven and is proceeding to build thereon a factory which will accommodate 500 to 600 workmen. The company is, meanwhile, manufacturing on a small scale at 215 Java street, Brooklyn. The new factory will be devoted to the manufacture of a number of new inventions, among which may be mentioned the "depolarite" batteries, which are made for bell and other open circuit work, and also for electroplating, electric lighting and motor work on a small scale. George Zucker's Sons, 108 Fulton street, New York, are sole agents for all the manufactures of the company relating to electroplating and galvanoplasty.

THE HARRISON INTERNATIONAL TELEPHONE CONSTRUCTION COMPANY, on account of the large demand for the Harrison telephone, has decided to move its general offices to the Chamber of Commerce Building, Chicago, where, in future, all communications relating to the establishment and construction of exchanges or lease of telephones should be addressed. The general office of the parent, or Harrison International Telephone Company, will remain as heretofore, at 44 and 46 Wall street, New York. On the 1st of August the Harrison International Telephone Construction Company will place on the market the Ford automatic switchboard, which is a device by which connection can be automatically made, and the central office and operator dispensed with.

SAMUEL W. RUSHMORE, 126 Liberty Street, New York, reports that his factory in Jersey City is completely filled with orders for arc lamps, search lamps, commutators and heavy dynamo repairs. He has just closed a contract to rebuild the dynamos of the North Attleboro Steam and Electric Company, of Pawtucket, R.I., whose station was burned last February, and has also arranged to rebuild the large and small machines that were but partly damaged in the fire of the Electric Power Company at St. George, Staten Island. He has orders on hand for twelve search lamps and Mangin mirror lamps, six for the Southern Pacific Steamship Company, and for a number of prominent yachtsmen. Some of the lamps are made specially for running on 500 volt circuits, and a number have been sold this season to railroads for exhibitions. Mr. Rushmore is now putting in some special machinery and will take on a dozen more men. He also reports having great success with the new spiral armature winding.

Business Notices.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED JULY 17, 1894.

522,964. MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS; H. D. Burnett, Lynn, and S. E. Doane, Swampscott, Mass. Application filed December 3, 1892. A fork for the manufacture of incandescent electric lamps, provided with a screw threaded tang, and handle of non-conducting material having a screw threaded socket to engage with this tang.

522,983. GALVANIC BATTERY; G. Hewitt, New York. Application filed September 19, 1893. In a gravity battery, a carbon battery, a carbon porous cup containing bichromate of potash crystals in combination with a solution of bisulphate of soda outside the carbon porous cup.

522,986. SYSTEM OF ELECTRIC DISTRIBUTION AND GENERATION; E. J. Houston, Philadelphia, Pa. Application filed November 17, 1887. The combination with a source of currents of low electromotive force of an induction coil having a low tension primary and high tension secondary, the commutator in the primary, the commutator in the secondary timed to change its connection in unison with the changes in the primary, the condenser across the terminals of the commutator, and the condenser across the terminals of the primary.

522,999. ELECTRICAL CONNECTION CORD; A. H. McCulloch, Boston, Mass. Application filed February 6, 1894. A flexible conductor consisting of a flexible non-conducting tube and a fluid conductor such as mercury, filling the same from end to end.

523,019. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; E. Thomson, Swampscott, Mass. Application filed February 10, 1894. In a commutator a series of sub-segments surrounded by a band whereby the sub-segments are held in place, in combination with an outer set of wearing segments secured to the sub-segments.

523,027. ARMATURE BAR AND METHOD OF MAKING SAME; G. Weber and C. W. Marcley, Rotterdam, N. Y. Application filed December 22, 1893. An armature bar wrapped with mica paper having a smooth finished surface.

523,055. PROCESS OF MAKING BATTERY PLATES; William L. Silvey, Dayton, O. Application filed September 9, 1892. The process of making secondary battery plates which consists in submerging a perforated cathode and a lead anode in combined alkali and acetic acid solution, connecting the cathode and the anode with a source of electrical supply and thereby depositing the metal of the latter in the perforations of the former, then removing the plates from the solution, next subjecting them to pressure to compact the spongy deposited metal, and finally washing them in water. (See illustration).

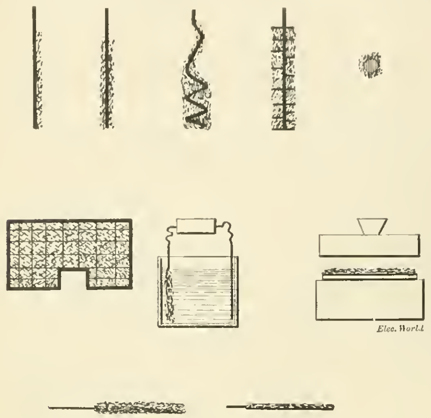
523,074. ELECTRIC SWITCH; Jesse F. Kester, Buffalo, N. Y. Application filed November 28, 1893. The combination with the contact block and the switch lever, of a face plate secured to the face of the contact block and consisting of a non-sparking composition, and a contact plate secured to the lever and adapted to pass from the block to the face plate upon opening the switch.

523,104. ELECTRIC RAILWAY SUPPLY SYSTEM; W. A. Butler, New York. Application filed March 16, 1894. In an electrical railway system, a series of contact devices arranged above the roadway at intervals and connected by a guide in combination with an elongated conductor carried by the car and having one or more grooved wheels running upon this guide.

523,119. QUADRUPLEX NEUTRAL RELAY; Charles D. Haskins, Brooklyn, N. Y. Application filed April 3, 1893. The combination with an electromagnet provided with a stationary core, of a pivotally mounted armature adapted to be affected by the electromagnet and serving as the core of a stationary helix of the electromagnet, the helices being equivalent as to magnetic inductive influence upon their respective cores, these cores being equivalent as to magnetic susceptibility; whereby reversal of the current flowing in the helices causes the magnetization of the cores to fall, change sign and rise in unison.

523,120. ELECTRIC SIGNALING APPARATUS; W. W. Hibbard, Rochester, N. Y. Application filed August 12, 1893. The combination of a main circuit provided with signal boxes, a side circuit, a magnet for controlling the side circuit, a differentiating apparatus with which both circuits are electrically connected, a circuit breaker driven by suitable mechanism and restrained by an electric stop, a magnet for releasing the stop, electrodes attached to the differentiating apparatus in line with the circuit breaker, and a magnet for operating a register at the central station.

523,121. ELECTRIC SIGNALING APPARATUS; W. W. Hibbard, Rochester, N. Y. Application filed August 12, 1893. The combination of a main circuit



No. 523,055.—Process of Making Battery Plates.

composed of two wires provided with signal boxes, a differentiating apparatus having electrical connections with the main circuit, a signal box attached to the main circuit, and a lateral circuit extending therefrom provided with thermostats or manuals.

523,122. DIFFERENTIATING APPARATUS FOR ELECTRIC SIGNAL SYSTEMS; W. W. Hibbard, Rochester, N. Y. Application filed August 12, 1893. The combination with a main circuit of a differentiating apparatus, two insulated electrodes with which the terminals of the main circuit connect, a circuit breaker provided with contact points which rest in line with the electrodes, and means for giving motion to the circuit breaker, the whole so arranged as to close the circuit through the main line by the engagement of the contact point with the electrodes and to open it by their disengagement.

523,123. ELECTRIC SIGNAL BOX; W. W. Hibbard, Rochester, N. Y. Application filed August 12, 1893. The combination with a main circuit composed of two wires, of a signal box attached thereto, a tripping device connected with one wire, and suitable electrical connections, the whole capable, when in action, of opening the wire, transmitting a signal over the other wire and of closing the first wire again after transmitting the signal.

523,124. ELECTRICAL SIGNAL BOX; W. W. Hibbard, Rochester, N. Y. Application filed August 12, 1893. The combination with a movable arm, resting over the face of the box, two manual stops, one in advance of the other, for restraining the movable arm, and an electrical stop succeeding the manual stops for restraining the arm, the electrical stop being controlled by an electromagnet.

523,132. MAGNETO CALL BOX; C. E. Scribner, Chicago, Ill. Application filed November 6, 1891. The combination with a calling generator, of a movable contact piece and a movable block, a fixed contact anvil and a fixed block mechanism in connection with the driving gear of the generator, allowing the movable block to bear against the fixed block and to close the movable contact piece upon the fixed contact piece when the generator is idle, and circuit connections joining the fixed block to a telephone line, the movable block and the movable contact piece to one end of the armature coil, the fixed contact anvil to the other end of the armature coil and to earth.

523,140. ELECTRIC MOTOR; J. F. Denison, New Haven, Conn. Application filed April 6, 1894. A barrel shaped armature core having a face curved in longitudinal section with alternate long and short ribs thereon, in the grooves between which are to be wound the armature coils.

523,144. ELECTRIC ARC LAMP; W. E. Frost, Lewiston, Me. Application filed July 31, 1893. The combination with top and bottom frame plates and posts connecting the same, of insulated collars surrounding the posts, and two part compound binding posts clamped together about the collars.

523,146. CONDUIT ELECTRIC RAILWAY; C. D. Jenney, Indianapolis, Ind. Application filed March 5, 1894. The combination in a conduit railway system of a conductor bar mounted to permit a vertical movement, frame work carrying the conductor bar and capable of a lateral movement, and springs attached to the bar and to the frame and operating to support or carry a portion of the weight of the bar.

523,160. ELECTRICAL CONDUCTOR; G. H. Blakesley, Bristol, Conn. Application filed April 7, 1893. A flexible conductor consisting of a body of flat tape into the edges of which are incorporated previously insulated wires or cables for transmitting electricity.

523,161. MEANS FOR VENTILATING ARMATURES; T. C. Coykendall, Rondout, N. Y. Application filed October 17, 1893. The combination with a dynamo-electric machine or motor, of a pulley having arms and fan blades mounted on the inner face of the rim between the arms thereof.

523,164. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; E. H. Johnson, New York, and Robert Lundell, Brooklyn, N. Y. Application filed December 19, 1893. A conducting contact brush secured by a pair of links or arms to a rigid support beneath the body of a car or vehicle, the arms being located in the same vertical plane and having parallel movement therein.

523,165. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; E. H. Johnson, New York, and Robert Lundell, Brooklyn, N. Y. Application filed January 16, 1894. A sliding contact brush detachably secured to a brush support having pivoted connection through a cross bar or standard with the body of a car or vehicle, in combination with a spring connecting the brush support and its sustaining standard whereby the brush is given positive downward pressure against the trolley conductor as the car advances.

523,166. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; E. H. Johnson, New York, and Robert Lundell, Brooklyn, N. Y. Application filed February 10, 1894. An electric railway provided with an insulating conduit and a series of branch or sub-feeder insulating conduits, the feeder conduit being embedded in the roadway and the sub-feeder conduits having their exterior ends secured in an insulating stringer or support which sustains a series of sectional trolley conductors.

523,172. ELECTRIC RAILWAY CROSSING INSULATOR; H. B. Nichols and F. H. Lincoln, Philadelphia, Pa. Application filed May 9, 1894. This comprises an arm of insulating material with a slotted and recessed body and having channeled metal wings with projections and detachable clamps, a seat of insulating material engaging the recesses portion of the arm, channelled metal arms formed with a slotted or recessed casting provided with forked ends engaging the arm and having curved projections on both sides thereof, and detachable clamps connected with the metal arms.

523,204. INCANDESCENT LAMP; W. E. Forest, New York. Application filed August 1, 1893. The combination of a globe provided with a conical neck, a perforated stopper fitted to the narrower portion of the conical neck, a perforated stopper fitted to the wider portion of the conical neck, a glass tube provided with leading wires inserted in the stoppers, and a body of plastic cement surrounding the glass tube and filling the space between the glass tube, the inner wall of the conical neck and the adjacent surfaces of the conical neck.

523,247. MAGNETO-ELECTRIC MACHINE; E. Tilmann, New York. Application filed November 22, 1893. An armature for magneto machines composed of a diametrical core, coils wound on the core, an insulating partition separating the coils and core plates extending over the coils.

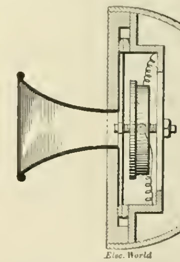
523,264. MATERIAL FOR MAKING ELECTRIC LIGHT FILAMENTS; G. A. Cannot, London, England. Application filed December 12, 1893. This consists of a thin yarn of peat fibre carbonized and treated in the ordinary way.

523,271. CONDUIT ELECTRIC RAILWAY; J. W. Eisenhuth, San Francisco, Cal. Application filed March 12, 1894. The combination of supporting chairs, an insulated conduit mounted thereon, an insulating partition dividing the conduit, conducting the wires mounted on each side of the partition in the conduit but insulated therefrom, and a trolley adapted to engage the conducting wires.

523,276. TELEPHONE TRANSMITTER; T. Grissinger, Mechanicsburg, Pa. Application filed May 24, 1894. In a telephone transmitter the combination with a diaphragm and fixed electrodes laterally connected with conducting wires, of a granulated variable resistance medium confined in contact with the electrodes and a plunger connected with the diaphragm and arranged to exert a varying pressure on the granulated material. (See illustration.)

523,278. ELECTRIC RAIL BOND; J. G. Hallas, Waterbury, Conn. Application filed May 1, 1894. A bond for rails of electric roads consisting of a body of uniform size having one or more coils formed from the metal of the bond, the ends adapted to be passed through adjoining rails, angular shoulders formed by bending the metal at a right angle, and which are adapted to set up against the under sides of the rails and the ends of the bonds to be headed down on the upper sides.

523,284. BONDING JOINT FOR ELECTRIC RAILWAYS; A. L. Johnston, Richmond, Va. Application filed May 5, 1894. The combination of a rail per-



No. 523,276.—Telephone Transmitter.

forated to receive a bonding connection, a bonding wire, with a nut adapted to the hole in the rail, the nut having a flange adapted to bear against the surface of the rail.

523,305. INCANDESCENT ELECTRIC LAMP; J. E. Criggal, Springfield, Mass. Application filed June 11, 1894. A tube of glass having the leading in wire which is extended longitudinally through it, a vitrified substance in the lower portion of the tube, a body of rubber cement next above and a body of plaster closing the mouth at the top of the tube.

523,306. ELECTRIC RAILWAY; H. A. Doty, Janesville, Wis. Application filed March 27, 1894. A conductor for electric ralways, comprising a covered wire and thin, flat, bare, projecting lugs rigidly secured to the wire and in longitudinal alignment.

523,313. ELECTRIC RAILWAY SYSTEM; R. M. Hunter, Philadelphia, Pa. Application filed March 14, 1889. The combination of a positive and negative working conductor for supplying current to the motors on the cars, a generator having one of its poles connected to one conductor, and its other pole connected with the other conductor through a variable resistance.

523,319. ELECTRICAL CONDUCTOR FOR TROLLEYS; J. W. Eisenhuth, San Francisco, Cal. This comprises a main conductor of low resistance and a series of short tubular conductors, each having permanent electrical connection with trolleys, etc.

The Electrical World.

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1881	" 28	" "	1888	" 175	" "
1882	" 45	" "	1889	" 234	" "
1883	" 63	" "	1890	" 289	" "
1884	" 82	" "	1891	" 325	" "
1885	" 100	" "	1892	" 316	" "
1885	" 138	" "	1893	" 317	" "

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CONTENTS.

ENGLISH JOURNALISM.

We are so used to reading slandering, stinging and cutting remarks in English journals about America and American inventions, that we have ceased to notice them, except when they furnish us amusement. They remind us of the snarling and barking of the little dog while he is safely behind his master's fence. But it seems to us that the editor of a prominent London contemporary, which we esteem too highly to name here, has gone beyond the bounds of courteous international criticism, when, in a recent issue, he replies to an American author, who, with pardonable pride, referred to the "American Republic" as "man's greatest political institution," by saying that the "political institution" is a "gigantic failure," and that it was converted "in one short century to a mere plutocratic tyranny." We hope the editor felt a little remorse when he saw his remarks in print, especially when he noticed that a large share of the articles in that very issue of his journal—three out of four of the leading technical articles—were of American origin, the fourth being an unacknowledged translation of a French article. While we do not mean to argue that good technical articles could not originate in a country which is a "gigantic failure" or a "mere plutocratic tyranny," yet it does seem to us that a country in which so much good and original work is being done in electrical and other branches of engineering deserves to be treated a little more respectfully than to be called a "gigantic failure." If the remarks of the editor were caused by a fit of indigestion, chronic liver complaint or some such ailment from which he was suffering, he ought to get a substitute until he feels better. Such remarks can do no technical paper any good.

RAPID TRANSIT IN BOSTON.

The majority of votes cast at the referendum election in Boston last week for a combined elevated and subway scheme of rapid transit finally gives sanction to that project, but judging from the violent letters written to the local newspapers in regard to it, the result seems far from producing general satisfaction. Both the system and the methods used to promote its adoption are energetically attacked, and there seems to be a prospect of a good-sized scandal in the future. As we have remarked before in these columns, underground electrical rapid transit plans seem to repel politicians everywhere as they did in Boston, apparently for the reason that they do not present the multifarious chances of "pickings" that elevated roads involve through condemnation and damage proceedings, street franchises, blackmail, etc. The rapid transit commission appointed by the Governor of Massachusetts in 1891 reported against underground roads for the reason that but little time could be saved if passengers had to descend below the surface fifty or sixty feet, and then reascend at the end of a mile or less, and the further reason that the shock from plunging into the "icy chill of these damp sub-cellars" would render their adoption of more than doubtful expediency—this in face of the success of electrically operated underground roads in Europe! As to the arguments that had weight in turning sole attention to the system adopted, the following extract from a signed letter in the Boston *Post* is significant: "In my opinion a bigger scheme for interior boodleism was never "carried through the Legislature. What the modus operandi of "securing and dividing the boodle will ultimately turn out to be I "do not know, nor any one else outside of the cabal who manipu- "lated the legislative wires and hypnotized the opponents of the "deal in the Legislature, and nearly all the Boston press. The "history of the so-called rapid transit in this State is a disgrace to "those who control such affairs, and I am convinced this last deal "will capsheaf the whole unsavory monument of selfish grasping on

"the part of corporations and would-be corporations and the weakness "ot legislators."

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The recent meeting of the Northwestern Electrical Association at St. Paul was so successful, not only in attendance, but in the character of the papers read, and the interest maintained throughout in the procceedings that the gentlemen at the helm whose skillful work led to this result deserve unusual credit. There was a noticeable lack of the merely perfunctory papers sometimes so painfully predominant at similar meetings, and if this characteristic is maintained there is no reason why the success of the present convention may not be repeated, and even surpassed. No greater mistake can be made by such bodies than to place upon their programme papers that contain no original value, and are merely collections of commonplace remarks strung together for the occasion. The paper that apparently came nearest to the interests of most of those in attendance was the very able argument of Mr. Allen Ripley Foote in favor of private against political ownership and operation of non-competitive public enterprises. The convention did well to order this paper printed for wide circulation, for the tone of it is such as not to arouse violent prejudices on eithe r side of the question. The arguments are of such a character that a partisan on one side may quote them to an equal partisan on the other with the assurance of a respectful hearing, and not with the usual result of further confirming prejudices. It will be seen that the position of Mr. Foote is not strictly an *ex parte* one, for while laying down the principles in favor of private ownership he also lays down the necessary ones for the protection of the public against possible abuses of such ownership. His contention is not that the private ownership and operation of non-competitive public enterprises shall be exercised as would be a strictly personal and private business, but that such owner shall have the advantage of the economic principles which do not conflict with the public welfare, not as a natural right, but because the public interests are thereby best served. This puts the matter in a light that will go far toward disarming the prejudice created in even perfectly fair minds by the intemperate claims of some opponents of public ownership. The paper of Mr. Page is a contribution to the subject of incandescent lamp economy which will be the more appreciated because it is not written from any theoretical point of view, but considers the question with reference only to the practical points involved, and the way these clearly affect the station manager. His remarks on the fallacies of giving undue weight to long life, and of expecting anything but bad results from raising the voltage on old lamps, as well as his observations on the desirability of uniformly maintained voltage, on keeping individual records of lamps, and on the relations to customers, cannot be too deeply considered by central station managers. In a future issue we shall discuss some of the conclusions of Mr. B. J. Arnold's paper.

FIRE ROOM ECONOMY.

The paper read by Mr. John C. McMynn at Chicago brings up a subject that will soon receive more general attention than it has in the past. Heretofore there have been so many other directions in which obvious savings in central and power stations could be made that the fire room has been neglected, but now that dynamo machinery is practically perfect, and the economy of the steam engine is receiving close attention, the considerable savings that may be made in the boiler department will, in turn, be taken up. It is well, therefore, to examine into the various factors influencing the efficiency of this department in order to see in what directions savings can be made, and the relative amounts. A boiler transforms the chemical energy of coal into the expansive energy of steam, and like in all other transformations of energy, perfect efficiency cannot be attained. To consume the coal air must be used, which at once introduces an element of inefficiency, for almost ninety per cent. of the weight of gas admitted passes off in an uncombined state, but with its temperature increased, and the part of the oxygen utilized, as well as the gases from the coal, also carry off heat. The less air admitted, therefore, and the lower its temperature when it passes into the atmosphere, the less heat will pass off. With mechanical stokers the former condition can be approximately attained, and only the exact quantity of air necessary for combustion admitted to the furnace. Through their use, therefore, an undoubted gain may be made, which, however, it seems high to place at 30 per cent. unless the hand firing superseded was unusually inefficient. The gain from mechanical stokers not only results from allowing a proper regulation of air, but also from preventing great wastes in opening furnace doors for firing, and in permitting a more efficient combustion of fuel, if accompanied, as we believe they always are, with means for mechanically working the fires. By increasing the ratio of the heating to the grate surface the outgoing gases will be further cooled, but as each square foot of such surface added decreases in heat absorbing power on account of the decrease in the difference of temperature between it and the outgoing gases, a commercial limit is soon reached, beyond which it would not pay to add further surface, and as in practice it is probable that such a limit has been attained, there is not much, if anything, to look for in this direction. The difference of temperature between the ingoing and outgoing gases may be decreased by heating the former, thus introducing a saving, but the reverse will be the case, it should be needless to say, if the steam in the boiler supplies the heat, as seems the condition in the case quoted in the discussion of Mr. McMynn's paper. The gases, after they have passed by the steam surfaces of the boiler, ordinarily can be drawn on for sufficient thermal units to heat both the entering air and feed water, but even here there is a limit with natural draft, for the gases must have a considerable temperature, depending upon the height of the chimney, to furnish the necessary draft head. With blowers, however, we have a different set of conditions, and their use, in connection with mechanical stoking, seems to present ideal conditions for efficiency. With blowers the air required can be regulated to a nicety, and for all rates of combustion; being independent of natural draft, the gases, after doing duty in the boiler, may be forced into a second chamber, and by passing over feed water surfaces and finally over thin pipes through which the air for combustion is drawn, their temperature may be reduced below a point possible with natural draft. The pressure at which the blowers should be worked will depend upon the mechanical obstruction offered by the above surfaces, and their useful heat absorbing area, so that without these data it cannot be predicted. For a given case it would be determined by the final temperature of the escaping gases. The only economy in the use of blowers is to reduce this temperature, and as the difference of temperatures between the boiler surface and gases cannot be economically reduced below a certain point it will be seen that feed water or air heating surfaces, or both, are necessary to attain this economy. There are cases, of course, where blowers may be used with economy, though leading to a direct waste of heat, as in stations with a sharp peaked load line where the waste, during the short time daily the blowers are used, may be more than compensated for by less first cost of boilers, less space occupied and less waste during the other hours from radiation, banked fires, etc.; also where a cheap grade of fuel may thereby be substituted for a more expensive one. It is probable that with the combination here outlined a boiler efficiency of probably 80 per cent. may be attained. At present 75 per cent. is a very high figure for boilers in normal condition, while 50 per cent. is perhaps nearer the usual efficiency, so that we have a margin of 50 per cent. for savings, though, of course, this will be reduced by the interest on, maintenance of, and cost of working the increased apparatus. We have assumed that condensing engines would be used with the boilers, for otherwise the cost of change to that type would ordinarily offer enough of an economical margin to put off the fire room for future attention. It has also been assumed that such obvious matters as boiler lagging and setting are attended to, for it would seem to be useless to expect an intelligent interest in any question from a man who loses 15 per cent. by an inferior boiler setting, though we doubt if such cases are as frequent as Mr. McMynn's remark would seem to imply.

Pupin's System of Cable Working.

Our esteemed American contemporary, The Electrical World, is somewhat put out at some remarks which we recently made with reference to Dr. Pupin's system of increasing the speed of working of submarine cables. If we have exceeded the bounds of courteous criticism in the remarks in question, we unreservedly withdraw them, though, at the same time, we must adhere to the main facts of our contention. When an invention is based wholly, or almost wholly, on theory, it is often extremely difficult to point to where the fallacy lies, and it is far better to bring forward the evidence of practical knowledge and experience to prove the argument. In the present case we chiefly based our remarks upon the results of very numerous experiments which we happen to know have been made during several years past by the electricians of the British Postal Telegraph Department upon Wheatstone automatic fast speed working. In order to obtain high speed on long circuits, it has been found necessary to introduce "repeaters" at intermediate points, so as to bring the working "K R" within the limits necessary to give the high speed. The apparatus for this purpose is somewhat complex, and in the course of the numerous experiments which have been made, a very great number of trials were carried out with shunted condensers at one or more intermediate points to see whether the division of the line with such condensers would not enable fast speed working to be obtained without the use of repeaters. The result of the experiments was to clearly indicate that the tendency of such contrivances was to reduce, and not to increase, working speed. The actual arrangements tried were much on the same lines as those indicated by Dr. Pupin, though possibly certain of the combinations suggested by the Doctor were not experimented with. We should be the first to congratulate the inventor if he could practically show that he has actually hit upon a method which effects the object which he theoretically believes he has arrived at; but in the absence of the application of the touchstone of experiment we must remain incredulous. We shall, however, look forward with interest to the development of Dr. Pupin's work, and hope that we have been mistaken in our estimate of it. It has been our fortune (or misfortune) on more than one occasion to have to listen patiently to the enthusiastic arguments of inventors, who with apparently perfect logic have conclusively proved their contentions, but in the end the disappointed inventor has nearly always found that the result has not been what he anticipated. Facts are stubborn things; an unfortunate citizen had managed to get in the meshes of the law and to be incarcerated in the county gaol; his legal adviser, who had been sent for, and had carefully listened to his client's statement of woes, after a little reflection assured him that he need not alarm himself. "I have carefully considered your statements, and am perfectly satisfied that you cannot possibly be imprisoned for what you have done." The unfortunate citizen did not seem much comforted. "What is the use of your telling me I can't be shut up? Confound it, man, here I am."—London Electrical Review.

Nikola Tesla.

The Sunday World of July 22 prints an interesting half-page article on Nikola Tesla, written by Mr. Arthur Brisbane, and accompanied by a portrait which we reproduce, without, however, the full caption which was as follows: "Nikola Tesla. Showing the Inventor in the Effulgent Glory of Myriad Tongues of Electric Flame After He Has Saturated Himself with Electricity." In deference to the well-known modesty of Mr. Tesla, we will not reproduce the newspaper writer's highly complimentary description of his personality and achievements, but confine ourselves to the following extracts, containing his remarks on the future of electricity and on the effects on the human body of high voltages coupled with high frequencies.

In answer to a question from the interviewer as to what he hoped to see accomplished by means of electricity, Mr. Tesla replied: "You would think me a dreamer and very far gone if I should tell you what I really hope for. But I can tell you that I look forward with absolute confidence to sending messages through the earth without any wires. I have also great hopes of transmitting electric force in the same way without waste. Concerning the transmission of messages through the earth, I have no hesitation in predicting success. I must first ascertain exactly how many vibrations to the second are caused by disturbing the mass of electricity which the earth contains. My machine for transmitting must vibrate as often to put itself in accord with the electricity in the earth."

When asked if he did not feel a little worried about taking a current of a quarter of a million volts, Mr. Tesla said: "I did at first feel apprehensive. I had reasoned the thing out absolutely; nevertheless, there is always a certain doubt about the practical demonstration of a perfectly satisfactory theory. My idea of letting this current go through me was to demonstrate conclusively the folly of popular impressions concerning the alternating current. The experiment had no value for scientific men. A great deal of nonsense is talked and believed about 'volts,' etc. A million volts would not kill you or hurt you if the current vibrated quickly enough—say half a million times to the second. Under such conditions the nerves wouldn't respond quickly enough to feel pain. You see, voltage has nothing to do with the size and power of the current. It is simply the calculation of the force applied at a given point. It corresponds to the actual pressure per square inch at the end of a water pipe, whether the volume of the water be great or

Nikola Tesla.

small. A million volts going through you doesn't mean much under proper conditions. Imagine a needle so small that the hole it would make in going through your body would not allow the blood to escape. Imagine it so small that you couldn't even feel it. If you had it put through your arm slowly, that would be, electrically speaking, a very small voltage. If you had it stuck through your arm with great rapidity, going, say, at the rate of a hundred miles a second, that would be very high voltage. Voltage is speed pressure at a given point. It wouldn't do you any more harm to have a needle shot through your arm very rapidly—that is to say, with high voltage—than it would to put it through slowly. In fact, if it hurt you at all, the slow operation would probably hurt more than the other. The question of danger is simply the size of current, and yet if a big enough current should be turned against you and broken with sufficient rapidity—if it should, so to speak, jerk back and forth an inconceivable number of times to the second—it wouldn't kill you. Whereas, if applied continuously, it would simply burn you up."

Practical Notes on Dynamo Calculation.—XII.

BY ALFRED E. WIENER.

26. Grouping of Armature Coils. Formula for Connecting.

A general formula for connecting the conductors of a closed coil armature has been given by Arnold[1] as follows:

If K = Number of conductors arranged around armature core;
a = Number of conductors per commutator segment;
b = Number of bifurcations of current in armature;
$b = 1$, single bifurcation, or 2 parallel circuits;
$b = 2$, double " " 4 " " ; etc.
P = Number of pairs of magnet poles;
y = "Pitch," or "spacing" of armature winding; *i. e.*, the numerical step by which is to be advanced in connecting the armature conductors;

then the number of armature conductors can be expressed by

$$K = a \times (P \times y \pm b),$$

from which follows the connecting formula for any armature:

$$y = \frac{1}{P} \times \left(\frac{K}{a} \mp b \right). \tag{63}$$

The general rule, then, for connecting any armature, is:

"Connect the end (beginning) of any coil, x, of the armature to the beginning (end) of the $(x + y)^{th}$ coil."

For the various methods of grouping the armature coils, the above formula is applied as follows:

a. Parallel Grouping.—In this method of connecting there are as many parallel armature branches as there are poles, viz.: $2P$ circuits, or P bifurcations. Spiral winding, lap winding and wave winding may be applied:

(1.) *Spiral Winding and Lap Winding.*—In this case the multipolar armature is considered as consisting of P bipolar ones, and independently of the number of poles, $P = 1$ and $b = 1$ is to be inserted in (63), and the formula applied to a set of conductors lying between two poles of the same polarity.

(2.) *Wave Winding.*—Here the actual number of pairs of poles, P, and the actual number of bifurcations, $b = P$, is to be introduced in (63), and the formula applied to the entire number of conductors.

b. Series Grouping.—This is characterized by having but two parallel armature circuits, or one bifurcation, no matter what the number of poles may be; for series connecting, therefore, we have $b = 1$.

In the special case of $P = 1$, bipolar dynamos, the series connecting is identical with the parallel grouping, and the winding may be either a lap winding (spiral winding) or a wave winding; the latter holds good also for $P = 2$; *i. e.*, for *four* polar machines. For dynamos with more than four poles, $P > 2$, however, series grouping is only possible by means of wave winding.

c. Series Parallel Grouping.—In the mixed grouping the number of bifurcations is greater than 1, and must be different from P, hence in the connecting formula we have $b > 1$ and $b \gtrless P$.

In this case there are either several circuits closed in itself, with separate neutral points on the commutator, or one single closed winding with b parallel branches. The latter is the case if y and $\frac{K}{a}$ are prime to each other; the former if they have a common factor; this factor, then, indicates the number of independent circuits.

27. Application of Connecting Formula to Special Cases.

a. Bipolar Armatures.

(1.) For any bipolar armature the number of pairs of poles, as well as the number of bifurcations, is $= 1$; furthermore, the number of coils per commutator bar is usually $= 1$; consequently $a = 1$, if in the connecting formula the number of conductors, K, is replaced by the number of coils, n. For ordinary bipolar armatures, therefore:

$$P = 1,\ a = 1,\ b = 1; \ldots\ldots y = n \mp 1 \tag{64}$$

(2.) If the number of commutator segments is half the number of armature coils, *i. e.*, two coils per commutator bar, then

$$P = 1,\ a = 2,\ b = 1; \ldots\ldots y = \frac{n}{2} \mp 1 \tag{65}$$

b. Multipolar Armatures with Parallel Grouping.

(1.) By multiplying the bipolar method of connecting, we have:

$$P = 1,\ a = 1,\ b = 1; \ldots\ldots y = n \mp 1 \tag{66}$$

This is a spiral winding; beginning and end of neighboring coils are connected with each other, and a commutator connection made between each two coils. The number of sets of brushes is $2P$.

For multipolar parallel connection and spiral winding with but two sets of brushes, either n divisions may be used in the commutator, and the bars, symmetrically situated with reference to the field, cross-connected into groups of P bars each—or only $\frac{n}{P}$ segments may be employed, and P coils of same relative position to the poles connected to each bar by means of P separate connection wires.

(2.) In connecting after the wave fashion by joining coils of similar positions in different fields to the same commutator segment, the following formula is obtained:

$$P = P,\ a = 1,\ b = P; \ldots y = \frac{1}{P}(n \mp P) = \frac{n}{P} \mp 1 \tag{67}$$

If y and n have a common factor, this method of connecting furnishes several distinct circuits closed in itself, the common factor indicating their number.

(3.) If P similarly situated coils are connected in series between each two consecutive commutator bars, only $\frac{n}{P}$ segments, but $2P$ sets of brushes are needed; the winding is of the wave type, and the connecting formula becomes:

$$P = P,\ a = P,\ b = P; \ldots\ldots y = \frac{1}{P}\left(\frac{n}{P} \mp P\right) = \frac{n}{P^2} \mp 1 \tag{68}$$

c. Multipolar Armatures with Series Grouping.

(1.) If all symmetrically situated coils exposed to the same polarity, by joining the commutator segments into groups of P bars each, are connected to each other, they can be considered as one single coil, and we obtain:

$$P = P,\ a = 1,\ b = 1; \ldots\ldots y = \frac{1}{P}(n \mp 1) \tag{69}$$

Each brush, in this case, short circuits P coils simultaneously.

The same formula holds good, if beginning and end of every coil are connected to a commutator bar each. The latter can always be done if P is an uneven number; but if P is even, the number of coils, n, must be odd. In the case of P uneven, if n is even, the brushes embrace an angle of 180°; but if n is odd, an angle of only $\frac{180^\circ}{P}$ is enclosed by the brushes.

(2.) Instead of cross connecting the commutator, the winding itself can be so arranged that only $\frac{n}{P}$ bars are required. In this case the connections have to be made by the formula:

$$P = P,\ a = P,\ b = 1; \ldots\ldots y = \frac{1}{P}\left(\frac{n}{P} \mp 1\right) \tag{70}$$

NOTE.—In drum armatures the beginning and end of a coil being situated in different portions of the circumference, they should be numbered alike, and yet marked differently, in order to facilitate the application of the above connecting formulæ. By designating the beginnings of the coils by 1, 2, 3,......, and the ends by 1′, 2′, 3′,......, this distinction is attained.

(To be continued.)

[1] E. Arnold, Die Ankerwicklungen der Gleichstrom Dynamomaschinen. Berlin, 1891.

Earthquake in Tokyo.

Mr. S. Katogi, of Tokyo, sends us an account of a violent earthquake which occurred at that place at 2 p. m. on June 20, in which several persons were killed and much damage done to electrical overhead lines and central station chimneys. Almost all telegraph, telephone and fire alarm service was interrupted, mostly through contacts between lines. Nearly all the brick buildings in the town were damaged more or less, while the brick chimney of the first station of the Tokyo Light Company was cracked very badly and the station put out of commission for three nights; the brick chimneys of the second, third and fourth stations were also cracked, but that of the fifth is an iron one and was not injured. The brick chimney of the Teikoku Station was damaged somewhat, but that of the Shinagawa, a brick structure protected with iron, was uninjured, as was also the iron chimney of the Fukagawa Station. We are informed that the lesson in regard to the futility of building brick chimneys in an earthquake country has been well learned this time, and that hereafter it is probable that none other than iron ones will be erected.

SECOND SEMI-ANNUAL CONVENTION OF THE NORTHWESTERN ELECTRICAL ASSOCIATION

ST. PAUL, MINN. JULY 18-19-20 1894.

THE second semi-annual convention of the Northwestern Electrical Association, held at the Ryan Hotel, St. Paul, on July 18, 19 and 20, was not only an event of interest to the section of the country most directly represented, but, from the high character of the papers read, one of importance to the electrical public generally. Leaving aside the many questions as to the desirability of electrical associations and societies embracing the local interests of various sections of the country, it cannot be denied that the results of the meeting of the North Western Association proved its usefulness and confirmed the expectations of those who labored for its success.

Our readers are more or less familiar with the Northwestern Association, its scope and objects. It is now in its second year, and its success seems assured. Though its second semi-annual meeting was held in the midst of an unparaleled business depression, when railroad travelling in the west was fraught with many dangers, a very large number of central station managers, owners and representatives registered at the Ryan Hotel, in addition to a great number of supply men and manufacturers, some of whom had exhibits in the corridors of the hotel. The electrical journals were also well represented, and the whole affair was most gratifying to the officers of the association.

The entertainment features of the meeting will long be remembered, the people of the "Twin Cities" having taken special pains to make their visitors welcome. All those who were present are already pledged to attend all future meetings.

The sessions of the meeting were models of dispatch and thoroughness. There was no lack of excellent papers, good talkers, and a spirit of eager participation in everything that was going on. To these features the success of the convention is largely due. We give below a detailed account of the varions sessions, and print elsewhere in this issue the excellent papers of Mr. A. D. Page, Mr. B. T. Arnold and Mr. Allen R. Foote, the former in full.

WEDNESDAY MORNING.

The association met at the Hotel Ryan at 10:30 a. m. Wednesday, July 18, 1894. In the absence of the president, Mr. C. C. Paige, of Oshkosh, Wis., the first vice-president, Mr. W. R. Baker, of Waupaca, Wis., called the meeting to order with a few appropriate remarks, and after the transaction of considerable business the session was adjourned to 2:30 p. m.

WEDNESDAY AFTERNOON.

In the absence of the author, Mr. Fred. De Land read a paper by Mr. John C. McMynn on "Economy in the Boiler Room."

Mr. McMynn referred to the desirability of good setting for boilers, stating that a saving of at least 15 per cent. can be effected in this respect with horizontal tubular boilers. The use of feed water heaters is urged, and the temperature of the feed water should be made to approach 212 degrees as nearly as possible, not only for economy but also to render the deposition of scale in them more certain. It is recommended that boiler compounds be selected with reference to the quality of feed water used, and a chemical analysis made to determine the question. Mr. McMynn recommends that whenever possible the fuel and water fed to boilers should be weighed or measured, and that a water meter be installed for the latter purpose; he also thinks that it would be economical to have the engineer make calorimetric tests of the quality of steam. Without entering into the relative merits of water tube and horizontal fire tube boilers, Mr. McMynn gives the following formula, which, he says will enable a decision to be arrived at in a given case:

$$X = A + C + W + \frac{B(1+b) + D + P(1+b)}{HN}$$

where B = cost of boilers.
P = " boiler plants.
b = rate of interest on above costs.
A = cost of attendance per h. p. hour.
C = " compounds and incidentals per h. p. hour.
W = " fuel per h. p. hour.
D = yearly cost of repairs.
H = horse-power.
N = number of hours plant runs per year.

The question of fuels is discussed, and it is stated to be economical to enlarge a plant to burn a cheaper fuel with less evaporation, the limit being the point where the interest on the investment equals the saving per year. While oil is approved, whether it will prove economical depends on the price and the number of boilers in a battery. It is stated that the Auditorium plant in Chicago saved $6,000 per year by using natural gas. Reference is made to recent improvements of the Pullman Company, which now employs the Hawley down draft with great economy, burning the refuse of the wood working shops and poor grades of coal, and has adopted the Warren Webster vacuum system.

In the discussion Mr. Debell spoke of the good results from burning slack coal with blowers which drew hot air from above the drum of the boilers, the temperature being raised to 200 degrees. Mr. Rau commended the Sellers-Galloway boilers, but Mr. Stewart thought that while this type was efficient the tubes were difficult to clean. Messrs. Stewart and Grover spoke highly of mechanical stokers, the latter stating that he had saved 30 per cent. by their use.

Prof. Shepardson then read a paper on "The Relations Between Technical Schools and the Electrical Industries," which made an earnest and manly plea for technical education. He referred to the vast amount of capital invested in electrical interests—probably not less than two billion dollars—and to the work of the various technical institutions throughout the country in educating young men who will be competent in a technical sense to fill the many important positions in this great field in which a special technical knowledge is necessary for success. He also referred to the wrong impression of some practical men of the work done by the technical schools, which is based upon the idea that the training is too theoretical and impractical. On the contrary, the technical schools are more and more teaching the fact that success in engineering may be obtained only by hard and unceasing work, and that the student must learn theory and practice together, that he must temper his theory with practice and govern his practice by theory. The students are urged by their instructors to spend their summer vacations of three months in electrical factories, repair shops, electric light and railway stations, in wiring or whatever way they may be able to gain experience in practical work. Under favorable circumstances they are urged to continue their experience through a full year before returning to complete their technical course, and in many cases after graduation the students return to work for the same concerns with which they spent their vacations. While a thorough grounding in theory is desirable, much importance must be given to actual experience, and the work of the courses is therefore made as practical as possible. Prof. Shepardson suggests what the relations between a technical school and the men engaged in electrical business should be. The schools aim to help the latter by educating men to help raise the standard of construction and repair work, and to assist in developing new industries and be of good service wherever they are located; by offering the facilities of libraries and laboratories for researches and original investigations; by providing the necessary facilities for making expert tests of efficiency, strength of materials, etc. In turn it is asked of those engaged in electrical industries to encourage the schools by encouraging the graduates, and to use the schools as employment bureaus. He also suggests that they aid the schools by sending to them samples and specimens, the results of peculiar accidents, and pieces from scrap heaps showing how different materials and apparatus stand use and abuse, pieces of discarded apparatus with reasons for its disuse, specimens of historical interest showing the steps of development, etc. The reading of the paper was followed by applause, and considerable discussion took place between the members as to the relative merits of correspondence and technical

schools, Prof. Shepardson advocating the latter, and Messrs. Brooks, Thorn, Norcross, Stewart and Sullivan contributing their views. In the evening a large party joined in an excursion to Lake Como, where a band concert was given for their entertainment.

THURSDAY MORNING.

After some discussion, upon the motion of Mr. E. L. Debell, the chairman, a committee of three, consisting of Messrs. Carroll Collins, Pliny Norcross and W. N. Stuart, was appointed to consider the advisability of making the secretaryship a salaried office, and their report advising that $75 should be appropriated for this purpose was adopted, though Mr. Thom, the present secretary, expressed a preference to give his services gratis.

After transacting various other matters of business, including instructions to the Committee on Schedule of Rates to make a compilation of central station statistics within six months and print 500 copies, Mr. B. J. Arnold read a paper on "The Cost of Producing Electrical Energy," which is printed elsewhere in this issue. The discussion which follows was participated in by Messrs. Kammeyer, Cuneo and Markle.

Mr. Chas. H. Chalmers then read a paper by Mr. Gilbert Donaldson, electrical engineer of the D. & D. Electric Company, on "The Modern Dynamo." Mr. Donaldson's paper, after sketching the general advance in dynamo construction, and referring to the progress in multipolar machines in particular, dwells on the subject of the new type of multipolar direct constant current closed coil arc dynamo recently put on the market. He states that the difficult point of these machines seems to be to get good automatic regulation and sparkless commutation, and referred to the various claims as to the proper shape of the pole pieces to obtain these ends. In some experiments of his own along these lines he found that so far as the sparking goes the shape of the pole pieces cuts a very small figure except in one case, which, however, is a very important one. If the dynamo is run, say, 25 or 50 per cent. below its real capacity, almost any pole piece will not spark, but above this the case is altogether different, and the shape has much to do with the sparking. The real point is to get sparkless commutation at maximum output. This can be done by putting plenty of iron in the polar tips, the effect of which is to get a more uniform field throughout, and also provide sufficient induction to balance the self-inductance of the short circuited coil when the brushes are well around toward the neutral plane, or line where the induced E. M. F. changes sign. No special shape is necessary, the requirement being simply to make the tips heavy and rather full, which allows the lines of force to spread out toward the tips and thus be of more uniform density. Another interesting way of securing a fairly uniform field is to make continuous pole pieces, but this has the disadvantage of reducing the capacity of the machines.

THURSDAY AFTERNOON.

The meeting was called to order by Mr. Debell, and Mr. C. K. Stearns read his paper on the "Economical Operation of Electric Light Plants." Mr. Stearns insisted upon the necessity of the installation of the most economical machinery and material, even though the first cost is greater, and the desirability of a strict system so organized that the manager ot a central station may know what each item is costing from day to day; he also strongly recommended the use of recording meters, preferably wattmeters. Much attention is paid in the paper to the subject of charging for lights, and it is held that the most economical method for both customer and company is the meter system, as it not only protects the central station, but checks extravagance on the part of the customer. It has been found in a number of cases that with the meter system the maximum load has been reduced at least 30 per cent. It is recommended that the change from flat rates to meters be made in the summer time when the lamp bill of the customer is at its minimum, as he will then have an opportunity to gradually introduce the necessary economy in the use of lamps before his bills are large. If the meter basis of charge were adopted, and the rate so placed that the customer would pay for the light *really needed* about what was previously paid before by contract for the wasteful service, the consumer would speedily learn to so economize as to use only what was necessary, thus reducing the real consumption, while practically the same income would be received. Consumers are almost always pleased with this arrangement because it leaves the amount of the bill entirely dependent upon their own economy. Another advantage of the wattmeter is that it will be a check not only upon the coal pile, but on the line, by acting as a detector of leaks, and on alternating circuits would indicate the loss of transformers, and thus lead to their best disposition. Mr. Stearns concludes his paper with descriptions of the various practical wattmeters on the market.

An interesting discussion followed, which was participated in by Messrs. Cuneo, Stewart, Grover, Thom and Rau.

Mr. Page then read his paper on "Incandescent Lamps: Their Use and Abuse," which we reprint elsewhere in this issue. Those joining in the discussion which followed were Messrs. Norcross, Thorpe, Stewart, Markle, Thom, Kammeyer, Arnold and Howell.

"A Question of Public Policy" was the title of an able paper, reprinted elsewhere in abstract, next read by Mr. Allen Ripley Foote, of Washington, D. C. Mr. Foote was interrupted several times by applause, and at the conclusion of the paper cheers and applause followed.

After tendering a warm vote of thanks to Mr. Foote for his paper, which was enthusiastically commended, and adopting resolutions thanking the various gentlemen who had contributed to the success of the meeting, the secretary stated that the next convention of the Association would be held in Milwaukee in January, 1895. On motion by Mr. Norcross, the following named gentlemen were elected to honorary membership: Prof. G. D. Shepardson and Messrs. A. D. Page, Allen Ripley Foote, Gilbert Donaldson, C. K. Slearns, B. J. Arnold and John C. McMynn. The evening was very enjoyably spent by the members as guests of Mr. Huey, representing the General Electric Company, and of the Babcock-Wilcox Company, in an excursion to Lake Harriet.

FRIDAY.

The day was pleasantly spent by the members in visits of inspection. Invitations were received to visit the central stations of the St. Paul Gas and Light Company, the power houses of the Twin City Rapid Transit Company, the electrical laboratory of the University of Minnesota, the central stations of the Minneapolis General Electric Company and the Minneapolis International Electric Company, the Electrical Engineering Company's store and offices, the D. & D. Dynamo and Motor factory, and Siemens, Brush, Standard and D. & D. isolated plants. An excursion to Minnehaha Falls was kindly arranged by Mr. Morgan Brooks, of the Minneapolis Engineering Company, and much enjoyed.

The following is a list of those in attendance:

BEAVER DAM, Wis. W. H. Thorpe. CHICAGO A. C. Bunce, W. N. Stewart, H. F. Latimer, H. B. Morgan, L. W. Burch, Fred. DeLand, F. E. Donohoe, C. E. Gregory, M. J. Sullivan, John R. Markle, Chas. S. Marshall, Chas. S. Cook, J. Stedman, B. S. Terry, M. C. Wheaton, J. B. James, Wm. Wilson, W. W. Low, S. T. Well, E. G. Neiler, B. J. Arnold, C. F. Gage, B. F. O'Hara, C. Kammeyer. CLEVELAND, O. B. F. Miles, J. G. Pomeroy. GREEN BAY, Wis. Carroll Collins. JANESVILLE, Wis. Pliny Norcross, E. P. Norcross. LA CROSSE, Wis. H. Amundson. LA PORTE, Ind. J. H. Harding. MADISON, Wis. C. Gunderson, MANKATO, Mich. R. E. Brown. MASON CITY, Ia. W. P. Fitch. MENOMINEE, Mich. E. T. Daniell. MILWAUKEE, Wis. H. C. Koch, O. M. Rau, T. R. Mercien, H. Andrae, G. H. Finn. MINNEAPOLIS, Minn., W. N. Stewart, Robert W. Bruce, Morgan Brooks, J. W. Hardy, F. J. Cram, J. H. Finney. A. S. Huey, Chas. Wilson, Prof. Sheparpson, A. M. Robertson, Gilbert Donaldson. NEW YORK, W. S. Howell, A. D. Page, J. L. Bell. OCONOMOWOC, Wis. Charles Cuneo. SHEBOYGAN, Wis. E. L. Debell. SIOUX CITY, Ia. H. C. Woodruff. SPARTA, Wis. J. M. Newton. ST. PAUL, Minn. J. G. Robertson, O. Claussen, W. J. Bonwell, F. S. Bradbury, J. J. Schoenleber, C. K. Stearns, B. Howorth, C. S. Timberlake. WASHBURN, Wis. W. E. Rentfrew. WASHINGTON, D. C. Allen R. Foote. WAUPACA, Wis. W. B. Baker, I. P. Lord, H. C. Thom, P. Irving. WAUWATOSA, Wis. T. F. Grover. WILSON CITY, Ia. W. P. Fitch.

SEEN AND HEARD AT THE CONVENTION.

THE ELECTRICAL ENGINEERING COMPANY, represented by Messrs. M. Brooks and F. J. Cram, did themselves proud in the way of entertainment. They were responsible for the delightful trip on the "Father of Waters," and the day visit to the various interesting points of Minneapolis. They received many compliments.

THE FORT WAYNE ELECTRIC CORPORATION interests were well served by Mr. John H. Finney, of Finney & Modisette, 811 New York Life Building, Minneapolis, who was in constant and watchful attendance upon everything that was going on.

WESTINGHOUSE, as usual, was to the front. Manager Cooke, of the Chicago office, had a brilliant little exhibit in the lobby, where he showed a bank of "stopper" lamps burning to perfection. He also had a Shallenberger meter in action.

THE GENERAL ELECTRIC COMPANY had something of a monopoly in way of attention. Messrs. Page and Howell did the honors for the lamp department, Mr. Page's admirable paper being one of the literary features of the convention. In addition to these two hustling and well-known experts, Messrs. Bunce and Wheaton, of the Chicago office, and Messrs. Stearns and Huey, of the Northwestern office, kept the name and specialties of this firm very much in evidence. Under the name "General Electric Company" were displayed a most complete line of its literature, as well as many of its most popular specialties.

BABCOCK & WILCOX boilers had things about their own way as boilers went. A very handsome model of this boiler was displayed, as well as sections of the boiler itself, full size. Mr. Chas. Wilson was in charge.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, sent their Mr. L. W. Burch, who succeeded in making a neat display of Metropolitan lamps. N. I. R. and I. X. L. wires, P. & B. Paints and Compounds, and other leaders handled by this leading house.

FAYERWEATHER & LADEW, manufacturers of leather belting, kept their name prominent at the hands of their Mr. H. B. Morgan, formerly with the Munson belting interests. His cards were well circulated.

BRONNELL'S SODIUM PHOSPHATE was described and made prominent through the medium of a neat little leaflet. The headquarters of this firm is at Cragin, Ill.

THE CHICAGO CROSS ARM COMPANY, through Mr. Chas. Marshal, of their Monadnock office, distributed some interesting data on woods used for cross arms. If the attending delegates did not secure a copy they should do so by writing the company.

THE SIOUX CITY ELECTRICAL SUPPLY COMPANY made a neat display of some of their specialties, one of which was "Clark's Patent Pulley Block." They also showed something new in the way of overhead insulating material. Mr. H. C. Woodruff looked after this interest very thoughtfully and energetically.

THE CENTRAL ELECTRIC COMPANY had an unusually good representative in Mr. H. F. Latimer. While he did not always move fast, he generally "got there" in good shape. Many kind things were said of this house and its specialties.

"SALAMANDER" WIRE was cleverly described in an attractive pamphlet entitled "Of Interest to All Parties Using Electric Wires." These were found about the hall, having been distributed by the makers of this famous wire, Messrs. Washburn & Moen, through their Chicago office. Mr. C. T. Gage, of this company was in attendance.

THE ELECTRIC APPLIANCE COMPANY had many advantages over the other exhibitors. In the first place, President Low, of that company, was one of the most popular men present, with his good cigars, and he was ably assisted by Mr. Wm. Wilson. His display consisted of a Packard transformer, Packard lamps, "O. K." and "Paranite" wires, and no end of assurances that the specialties of this house could always be relied upon. It developed that this company had many friends in the association.

SWAN LAMPS were well handled by Mr. James G. Pomeroy, who made a very neat still exhibit of many types of this lamp.

E. & D. MOTORS AND DYNAMOS came into prominence through the paper of Gilbert Donaldson on "The Modern Dynamo." This apparatus is manufactured in Minneapolis, and is well known in the Northwest.

C. E. GREGORY, of Chicago, without whom an electrical convention would have a missing link, was exceedingly popular, and succeeded in distributing scores of his little "Handy Directory." Mr. Gregory is starting on quite an extended pleasure trip.

GOODRICH HARD RUBBER SPECIALTIES were represented by several placards, and that cleverest of all clever pamphlets, "Things Are Not Always What They seem."

THE SIEMENS-HALSKE interests were handled by Mr. W. N. Stewart, who came into prominence by his advocacy of the new 220-volt incandescent lamp.

HERMAN ANDRAE, of Milwaukee, represented the elder Andrae, and made numerous friends.

J. R. MARKLE, Western manager of the Chloride Battery interests, did much to advance the cause of storage batteries in central stations, both in and out of the convention hall.

THE WESTERN ELECTRIC HEATING COMPANY made a very handsome display of their heating apparatus. This included a full line of electrically equipped domestic devices. The exhibit was in charge of Mr. C. S. Timberlake, the St. Paul special agent of the company.

F. E. DONOHOE, Chicago manager of the American Electrical Works, Providence, R. I., was another convention favorite. Mr. Donohoe has started in well with his Chicago office, and every one predicts for him a great success.

THE NATIONAL CARBON COMPANY, Cleveland, sent Mr. B. F. Miles as their representative. Their action proved a shrewd business move, as Mr. Miles did the honors in great shape.

A. C. BUNCE, of Chicago, one of the leading spirits of the association since its inception, and the chief jester of the St. Paul meeting, seemed to have no end of friends, and made no end of fun.

THE OFFICIAL BADGE of the convention was a very handsome affair. It consisted of a pendant ring from a cross bar in the centre of which hung a miniature incandescent lamp, this being attached to a bit of blue ribbon. Below the ring the different grades of membership were designated by the words "Associate," "Active" and "Honorary."

E. G. NEILER, one of the World's Fair electrical engineering staff, represented the firm of Pierce & Richardson, of Chicago.

A Question of Public Policy.*

SHALL PUBLIC SERVICES BE RENDERED BY POLITICAL OR PRIVATE MONOPOLIES?

BY ALLEN RIPLEY FOOTE.

Mr. Foote takes as his text a plank from the platform of the Knights of Labor, which demands that the government shall obtain possession, under the right of eminent domain, of all telegraphs, telephones and railroads; and that hereafter no charter or license shall be issued to any corporation for the construction or operation of any means of transporting intelligence, passengers or freight. The various economic questions concerned in the question of public ownership are thoroughly discussed, and the arguments of Prof. Richard T. Ely and his school dissected. It is maintained that if all men were good, perfect results might be attained, but that as we must take human nature as we find it, our choice lies, in the management of public non-competitive enterprises, between political monopolies controlled by imperfect men and managed by imperfect men—just now known as political bosses—and private monopolies owned and managed by the same kind of men. The former course is likely to lead to corruption, and finally to tyrannies, while the latter is most likely to develop the inherent economic advantages, of which, however, the private owner by proper legislation may only be permitted to enjoy those that result from the industry and saving which he alone will exercise, which creates its own profit, and which it is a natural right vested in him to enjoy. Mr. Foote then lays down a definite declaration and statements of public policy which we reproduce in full.

The best interests of the public welfare require, whenever a municipality can obtain a service for the supply of a municipal need, without creating a public debt or the investment of tax payers' money for such purpose, at a cost to the users of the service not greater than it would cost if supplied from a plant owned and operated by the municipality, by contracting with a private company to supply such service, that the municipality shall have authority to make such a contract in accordance with the best economic conditions. These conditions require, in consideration of the investment of private capital for the purpose of supplying a public service, and the organization by the owners of such capital of a company responsible for the proper management and satisfactory supply of such service, that the municipality shall secure to the company by contract the full enjoyment of economic advantages that shall be the equivalent in every respect of the economic conditions that the municipality would enjoy if it owned and operated on municipal account a plant for supplying the same service.

A municipality shall have authority to acquire the complete ownership of any plant owned by a private company and operated by it under contract with the municipality for supplying a public service, by paying the full value of the same when judicially determined, whenever it has been demonstrated beyond a reasonable doubt by judicial investigation that an economic gain for the public welfare can be secured by such action, sufficient in amount to justify such change in public policy, and then only.

To safeguard the public welfare, all contracts made under authority of this provision shall stipulate that the company is to erect and to extend its plant so as to supply the service, in the best known manner and at the lowest practical cost to the users of the service, to every section of the municipality whenever and wherever the municipal authorities may from time to time require; that it shall fix its charges for the public, commercial and private use of the service it renders at such rates as shall be only sufficient to cover interest on its outstanding shares of stock and bonds legally issued, at the same rate the municipality pays on its bonded debt, a reasonable allowance for the depreciation of the value of its plant from use, accidents and contingencies, all operating expenses, and the value of all material consumed in the processes of operation and ordinary repairs, and a net profit for dividends of not to exceed 10 per cent. per annum. All such contracts shall stipulate that the prices fixed by the company for the service it renders shall be subject to review by the municipal authorities at the termination of regular periods of five years each; that the extension of the service plant, the adoption of improved apparatus, methods of distribution or system of management, designed to render the production or final use of the service better or more economical, may be required by the municipal authorities at any time.

To safeguard the welfare of the contracting company contracts shall stipulate that no extension of the service plant, change of apparatus, method of distribution or system of management shall be required by the authorities of a municipality unless the rate of charges for services rendered, and the income from the same actual or prospective, be sufficient to fully pay the considerations for service rendered herein specified, but the contracting company may consent to make extensions or changes of any kind whenever requested to do so by the municipal authorities without reference to the effect such changes may have upon investment in relation to income.

In case of a disagreement of any kind between the authorities of a municipality and a contracting company, such disagreement shall be settled by a Board of Arbitration selected for the special purpose, the company naming one, the municipal authorities naming another, and the two members so selected naming a third, the findings of the Board of Arbitration so selected to be final and binding upon the company and upon the municipality.

*Abstract of a paper read before the Northwestern Electrical Association, St. Paul, Minn., July 19, 1894.

Incandescent Lamps: Their Use and Abuse.*

BY A. D. PAGE.

In the present state of the art of incandescent lighting, in no way can central station managers increase the efficiency of their investment more than by careful study of ways and means of operating lamps in a manner which will insure an average maximum light for a minimum expenditure.

Too large a percentage of central stations judge the quality of lamps sold them almost entirely by their life, and even that poor basis of calculation is still further distorted by keeping no ampere records nor averaging results, but judging solely by the individual records of such lamps as may fail in the first hundred hours, or of those which live hundreds of hours past the point at which, from an economical standpoint, they should have been broken. The importance to central station managers of judging lamps which are sold to them from some better basis than individual or even average life can be better appreciated by referring to Fig. No. 1, showing curves of deterioration in candle power of lamps manufactured by different companies. (In considering deterioration in candle power, it should be stated that it is a characteristic of every lamp which has yet been manufactured and should be considered entirely independent of blackening or discoloration of the bulb. Lamps may deteriorate to 50 per cent. of their initial candle power within two hundred hours and still show scarcely a trace of blackening.) All lamps, the curves of which are shown, were purchased within six months in the open market in lots of from ten to twenty-five, and the curves are the average result obtained by starting each lamp at the particular voltage which would bring the lamp to exactly 3 watts per candle, maintaining the voltage constant throughout its life.

Curves 3, 5 and 6, Fig. 1, represent the best results obtained from the product of numerous foreign manufacturers. Curves 4, 8, 9, 10, 11 and 12, each represent a different domestic manufacturer.

While there is no reason to suppose that the average life of lamps shown by curves 4 and 7 will be shorter than that of lamps represented by curves 10, 11 and 12, there is also no certainty that it will be longer, and if a lamp is to be branded as poor by the central station manager, because of the breakage of a small percentage of lamps in the first one hundred hours, then the advantage is in favor of the lamp which reached 50 per cent. of its original candle power in the first two hundred hours, thus maintaining the carbon at a high degree of incandescence with the necessarily greater strain of the filament for only a few hours.

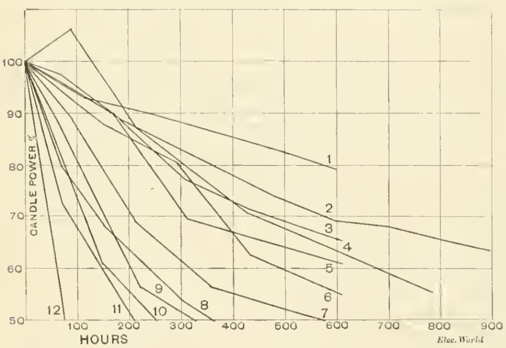


Fig. 1.—Curves of Candle Power.

The carbon which maintains its candle power must continue to burn at a higher temperature, nearer the point of vaporizing, and is more likely to be destroyed by an abnormal increase in pressure than one which cools within the first few hours to a point where considerable increase in voltage is required to bring it to its initial degree of heat or incandescence.

From the standpoint of the central station, one of the worst guarantees that you could demand from the lamp manufacturer would be an individual life (for each lamp) of one or two hundred hours. The reason for such demand, when made on your part, arises from the erroneous impression that the lamp which lives only one to two hundred hours is necessarily defective. Nearly every lamp sold you, and particularly those which show the best results, rises in candle power for the first few hours (this is not shown in Fig. 1, as in only one case was the first test after the lamps were started made before the candle power commenced to drop).

On nearly every central station, particularly on alternating current stations, during light load, the pressure on the primary is abnormally high. Add to this the difference between drop in the transformers and secondary wiring, as between full and light load, and the result which a test is quite certain to show is pressure on the one or two lamps which the customer is burning during light load from 6 to 10 per cent. high.

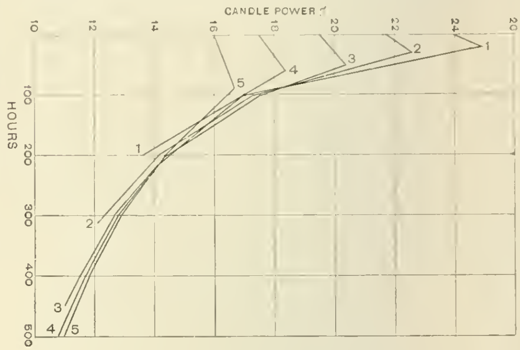


Fig. 2.—Curves of Candle Power.

Referring to Fig. 2, we find that burning a new 16 c. p. 3½ watt lamp 7 per cent. high would, for the first few hours, raise its candle power to 25, and its efficiency to about 2.6 watts per candle. In less than one hundred and fifty hours, even maintaining the high pressure mentioned, the candle power and efficiency would fall below normal; but in the meantime, the new lamps which have been burned under the above conditions have been abused to an extent which would be quite certain to make the showing of some individual lamps very poor, *through no fault of the lamps.*

After lamps have been in use about two hundred hours, under average conditions, they could then be used where the pressure was high, without bringing the carbon to a dangerous degrees of incandescence.

One of the best illustrations I can give of the importance of your judging lamps from some better standard than simply life, is to refer to an incident of which I had reliable information, where a representative of the lamp company, who manufactured the lamps shown by curve 12, Fig. 1, exhibited the valuable quality possessed by his lamp standing very high pressure. With a rheostat it was exhibited burning from normal to a very high candle power. He represented it as the *toughest* filament ever placed in a lamp, and I have no cause to disbelieve him.

If central stations run with a variation of from 6 to 20 per cent. in pressure, they will find it necessary to demand *tough* lamps, the natural product of the *amateur* lamp manufacturer. To bring a product up, however, even from curves 9, 10 and 11 to curve 4, means experience and thousands of dollars spent in experiments.

It also means that each one of over fifty different operations through which the parts of a lamp pass from start to finish should receive careful, intelligent handling or direction. Perfection in any one particular will not attain even average results.

The manufacturer of lamps shown by curve 4 might have furnished the same carbons to manufacturers of lamps represented by curves 10 and 11, and the result which they would obtain would not differ materially from that secured with their own make of carbons. Curve 4, though it represents as high an average grade of lamp of any voltage above 100 as has yet been furnished to the customers of any lamp manufacturer, does not represent the highest point which will be attained.

* A paper read before the Northwestern Electrical Association, St. Paul, Minn., July 19, 1894.

Curves 1 and 2 represent experimental lamps manufactured and furnished for test by the same company, whose regular product is represented by curve 4, and I am informed by reliable experts that within a few months the entire product of the company will be brought up to the standard represented by curve 1.

That the relative value of the lamps represented by these curves may be fully appreciated, let us take the average candle power of curve 1, Fig. 1, which for six hundred hours is 14-19 candles, and we find, to maintain the same average candle power, using other lamps, we should have to break lamps represented by curve 4 at five hundred and thirty hours; curve 7 at one hundred and seventy hours; curve 8 at one hundred hours; curve 9 at one hundred and twenty hours; curve 10 at ninety hours; curve 11 at seventy-five hours, and curve 12 at thirty-five hours.

All of the lamps represented by Fig. 1 are of voltages from 100 to 125 volts, and though started at a higher economy (vs. 3 watts per candle) than is commonly practiced by central stations (the 3.1

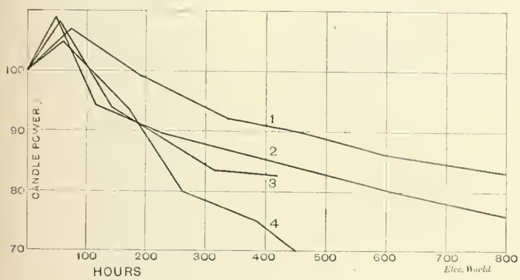


Fig. 3—Curves of Candle Power.

standard of Edison illuminating companies being the highest of which I have personal knowledge). Testing at 3 watts comes nearer to results obtained by commercial practice than a lower initial economy, as the tendency of the average central station is to run high.

Fig. 3 represents lamps of from 50 to 60 volts, started at 3 watts per candle, and tested under the same conditions as the 100 to 120 volt lamps.

No. 1 is the product of the same factory as Nos. 1, 2 and 4, Fig. 1. No. 2 was manufactured by the same company as No. 9. No. 3 was manufactured by the same company as No. 11. No. 4 was manufactured by the same company as No. 10.

As proven by these curves, and also, I believe, as generally acknowledged, it is much easier to produce a fairly good 50 volt lamp than one of a voltage above 100; but, considering the progress which has been made within the past year in the high-volt lamps, I believe that in a short time a large percentage of alternating current central stations will find it to their advantage to use large transformers and secondary mains on the three-wire system, covering one or more blocks from one transformer or bank of transformers, and using only lamps of over 100 volts, thus greatly economizing in copper and securing much better regulation than is now secured with numerous small transformers and 50 volts on the secondary.

The importance of good regulation or a constant voltage at the lamps is too little appreciated, the general opinion of central station managers apparently being that so long as the life of the lamp is satisfactory to themselves or their customers, if they increase the voltage either temporarily or permanently, the result would be to increase the average light. The facts are that burning lamps above their normal rating decreases the entire average candle power on the customers' circuits, and at the same time, if the station is on a meter basis, increases the amount of the customers' bills. The above statement is particularly true of lamps only of average quality.

Referring to Fig. 2, curve 5 represents a 108 volt, 16 c. p., 3½ watt lamp burned at a constant voltage and reaching 11 candles at five hundred hours. Starting the same lamp at 110 volts or at 17½ candles, 3.3 watts per candle, inside of two hundred hours the candle power curve crosses the one burned at normal. Starting it at 112 volts or at 19½ candles, 3.1 watts per candle, in less than two hundred hours the candle power curve crosses both the others.

Curves 1 and 2 follow the same general law. The higher we raise the voltage the more rapid the drop in candle power, and when we consider that the lamp represented by curve 1 must be kept at 116 volts in order to give 14 candles of light after two hundred hours, and that should the voltage be brought back to normal or 108 volts, the candle power would be only about 9 candles, we can appreciate that on a station where the voltage varies even 7 per cent. the result must be a very uneven and poor quality of light, even though the life of the lamp is satisfactory.

The tendency of all central stations seems to have been to gradually raise their voltage with the intention of thus either burning out or increasing the candle power of the old lamps on their circuits. The result is only to either burn out an abnormal number of new lamps or bring them down to the candle power level of the old ones within two hundred hours.

The only practical method of keeping the average candle power of lamps on a station at a point which will be satisfactory to customers or on a competitive basis with other methods of lighting is to keep records of the average life on the entire station where free renewals are furnished and then to take out of the sockets and break up all lamps which are dim, by this means keeping down the average life to whatever constant is decided as the best under local conditions. Where lamps are sold to customers, to keep the candle power of lamps in use on the circuit of a central station at a point which will insure satisfaction or tend to keep the electric light popular, is a difficult problem. Whether the customer is on a meter or on a contract basis, it is poor economy for him to keep lamps in his sockets which are giving only 50 per cent. of their initial candle power, but for the corporation which sold him the lamps and supplies him with current to call his attention to the fact that lamps in his sockets are giving only about 8 candles, and to attempt to sell him lamps at 50 or 60 cents each, is not likely to bring about the desired result. To meet the above difficulties a number of central stations in different parts of the country are now selling lamps at retail to their customers at cost, and a few stations even below cost, at the same time doing all in their power to prove to them that only by a liberal use of lamps can they obtain the greatest amount of light for a given expenditure of money.

As the profit on the sale of lamps is decidedly a secondary matter as compared to the sale of current and the increased quality of the light, the above plan should commend itself to all central stations not on the basis of furnishing free renewals. It is also worthy of consideration that by adopting the above plan the station controls what lamps shall be used on its circuits without dictating to its customers, an important point while lamps show such widely different results as those shown by Fig. 1, and while customers continue more likely to believe that the corporation is not supplying proper current than to believe that the quality of lamps they have been purchasing is at fault.

Another method of inducing customers to destroy dim lamps which has found favor with a number of stations is to make a price

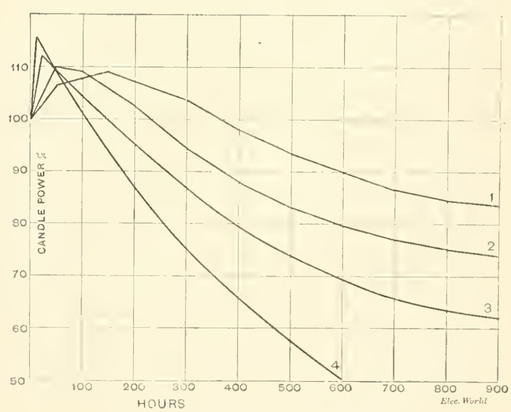


Fig. 4—Curves of Candle Power.

for lamps of say 40 cents each, and agreeing with their customers to exchange all dim lamps (which they have sold them) at half price, that is, for every dim lamp which the customer returns before the carbon is burned out he receives a new lamp for 20 cents.

Within the past few months the question has often been asked me by central station managers, "What economy of lamps should we use?" This question should, I believe, be settled by central station managers themselves on presentation of facts, they having control of the regulation of their station and knowledge of local conditions.

Fig. 4 shows the same quality of lamp manufacture as curve 2, Fig. 1, and represents 16 c. p. lamps started at an initial economy of 4, 3½, 3 and 2½ watts per candle. The accompanying table shows candle power, average candle power, average economy and average candles per electrical horse power at one hundred hour periods in their life.

In considering these curves and table it should be remembered that the result would have been much less favorable to the higher economy lamps had the test been made and the curves plotted with a poorer quality of lamp, and also that satisfactory results with lamps of higher economy than 3½ watts per candle can only be obtained by exercising the greatest care in maintaining a constant voltage at the lamps. Referring to the table briefly, it will be found that even at six hundred hours lamps of the highest initial economy show the best average result as to average watts per candle and average candles per horse power, and that at nine hundred hours 3 watt lamps show better average results than lamps of 3.6 or 4 watts. The greatest objection which can be urged against the high economy lamp is that while at nine hundred hours the 4 watt lamp reaches a minimum candle power of 13¼ candles, and the 3½ watt lamp about 12 candles, the 3 watt lamp reaches 10 candles and the 2½ watt lamp at six hundred hours reaches 8 candles. At the present price of lamps, where fuel is high and the customers' bills are made up on the basis of lamp hours, it would, without question, pay the station to use high economy lamps, breaking them at a point which would insure satisfaction as to average light and keeping the average life comparatively short.

Whatever economy or make of lamp you decide to use, by no means can you so greatly increase the efficiency of your station as by making every possible effort in the direction of maintaining a constant voltage at the lamps. This can only be accomplished and maintained by constant use of reliable, portable instruments. No switchboard instrument should be relied on, without often checking it by some reliable standard, and it should also be borne in mind that, owing to the varying drop at various loads, constant voltage at the station is just what is not wanted. If you do not possess a reliable, portable voltmeter, such an instrument should be your next purchase, then by constant use on your circuits at different loads and profiting by the knowledge thus obtained, you would soon find a marked improvement in your lighting, and would be in a position to judge which make and what economy of lamp is the best for you to purchase.

		64 Watts	56 Watts	48 Watts	40 Watts
100 Hours—	C.P.	17.28	17.44	16.8	16.16
	Average C.P.	16.8	17.06	17.09	16.96
	Average Watts per Candle	3.9	3.28	2.8	2.36
	Candles per E.H.P.	191.	227.	266.	316.
200 Hours—	C.P.	17.12	16.32	15.2	14.08
	Average C.P.	17.03	16.94	16.51	15.97
	Average Watts per Candle	3.76	3.3	2.9	2.5
	Candles per E.H.P.	198.	226.	257.	298.
300 Hours	C.P.	16.64	15.04	13.92	12.
	Average C.P.	16.96	16.53	15.86	14.96
	Average Watts per Candle	3.77	3.39	3.03	2.67
	Candles per E.H.P.	198.	220.	246.	279.
400 Hours—	C.P.	15.68	14.08	12.8	10.56
	Average C.P.	16.74	16.	15.2	14.03
	Average Watts per Candle	3.82	3.5	3.16	2.85
	Candles per E.H.P.	195.	213.	236.	262.
500 Hours—	C.P.	15.	13.28	11.68	9.12
	Average C.P.	16.45	15.57	14.62	13.2
	Average Watts per Candle	3.89	3.59	3.28	3.03
	Candles per E.H.P.	192.	208.	227.	246.
600 Hours	C.P.	14.40	12.8	11.04	8.
	Average C.P.	16.	15.15	14.08	12.43
	Average Watts per Candle	4.	3.7	3.41	3.22
	Candles per E.H.P.	187.	202,	219.	232.
700 Hours	C.P.	13.92	12.32	10.56	....
	Average C.P.	15.84	14.78	13.23	....
	Average Watts per Candle	4.04	3.79	3.52	....
	Candles per E.H.P.	185.	197.	212.	....
800 Hours—	C.P.	13.6	12.	10.24	....
	Average C.P.	15.6	14.45	13.63	....
	Average Watts per Candle	4.1	3.88	3.62	....
	Candles per E.H.P.	182.	192.	206.	....
900 Hours—	C.P.	13.28	11.84	9.92	....
	Average C.P.	15.36	14.18	12.88	....
	Average Watts per Candle	4.17	3.94	3.73	....
	Candles per E.H.P.	179.	189.	200.	....

American Fire Department Outdone.

It appears that the members of the Italian fire brigade are very prompt in responding to alarms of fire. According to an illustration in "L'Elettricita," the firemen arrive at houses struck by lightning before the lightning flashes disappear from view.—London Electrical Engineer.

Cost of Producing Electrical Energy.*

BY B. J. ARNOLD.

The losses between indicated and electrical horse power in a fairly well designed high speed, belted, direct current station, are about as follows: Engines 10 per cent., belts 4 per cent., dynamos 10 per cent., line 10 per cent., making a total commercial efficiency of 70 per cent.

In alternating direct belted plants the losses on engines, belt and dynamos are practically the same as given above. The losses in the primary circuit are usually 5 per cent. Where there are many small transformers and when working under loaded, as they usually are for a large portion of the time in small central stations, the average loss will be about 10 per cent., although when they are working at their rated load they will give an efficiency of 93 per cent. to 95 per cent. The loss on the secondary wiring is usually 2 per cent. Combinin these losses, we find the average commercial efficiency of the alternating plant to be 65 per cent. In stations operating large engines belted to a countershaft the losses are practically the same as given above, except that the loss between the power delivered by the engine and the power delivered to the generators is usually about 20 per cent., making the commercial or industrial efficiency of the above systems 58 per cent. and 52 per cent. respectively, although there are many cases on record in which the losses are far greater than these, caused by unsoldered joints in the line construction, or defectively designed and operated machinery.

Table No. 1, published recently in L'Industrie Electrique, was prepared by Mr. J. Laffargue. I have reproduced it here, as it contains the most complete information regarding foreign central stations that I have been able to secure. The stations are all located in Germany; two of them, those at Elberfeld and Hamburg, being direct current plants, the one at Cologne an alternating station, and those at Barmen, Hamburg and Dusseldorf direct current stations with accumulators as auxiliaries. The table enables us to compare the relative merits of the three systems, and as will be noticed, the alternating station at Cologne produces 71 watt hours per pound of coal, and delivers a kilowatt to the customer for 6.65 cents. The station at Hanover produces the greatest number of watts per pound of coal, viz., 219, and delivers a kilowatt hour to the consumer for 5.2 cents, while the best result of all is shown by the station at Dusseldorf, producing, as it does, 185 watt hours per pound of coal, and furnishing a kilowatt to the customer for 4.54 cents. This would seem to indicate that there is an advantage in using accumulators.

It is also interesting to note that the average commercial efficiency of the accumulators is 76.1 per cent.

Mr. Laffargue adds that the following percentages are allowed for depreciation: 1½ to 2 per cent. on the buildings; 4 to 5 per cent. on the boilers and engines, and 6 per cent. on the accumulators; 3 per cent. on the mains, and 8 to 10 per cent. on the various auxiliaries of the plant. These figures are about correct for practice in this country, except on the accumulator question, and as there are now numerous strong companies entering the field in this country, who are willing to guarantee to maintain battery plants for 10 per cent. per annum, it is possible that we can soon reach the state of perfection in the line that is indicated by these figures.

In comparing the figures on a basis of cost per kilowatt hour delivered to the consumer, the loss in the mains at the various stations should be taken into consideration, as it will be noticed that at Dusseldorf the loss between the station and the consumer is over 30 per cent., at Hanover 20 per cent., Barmen 15 per cent., while at Hamburg and Elberfeld it is but 5½ per cent. and 2½ per cent. respectively. Were these allowances made, it would probably bring the cost at Dusseldorf much below the present figure, but not knowing the exact conditions it was impossible to make the proper allowance in this paper.

The first part of table No. 2, marked "Direct Current," was prepared from reliable information on file in the writer's office, and is

*Abstract of a paper read before the Northwestern Electrical Association, St. Paul, Minn., July 19, 1894.

the result of the operation of fifteen large direct current stations located in different parts of the United States. The three succeeding parts of the table marked "Direct Current," "Alternating Current" and "Combined Systems," have been compiled from information secured from the report of the committee on statistics of the National Electric Light Association, presented at its last meeting, and figures were chosen only from such stations as seemed to bear evidence of careful compilation. This report did not give the cost of coal per ton, nor the cost of coal per kilowatt hour, but simply gave the watt hours produced per pound of coal. By assuming a price per ton on the coal we have deduced the costs per kilowatt hour which are given, but not having the information necessary to ascertain the operating expenses or fixed charges, the total cost per kilowatt hour delivered to the consumer is omitted.

In general, however, I will state that the expense of operating in central lighting stations, is approximately as follows:

Fuel	23.15	per cent.
Labor	21.20	"
Lamps	7.75	"
Repairs	13.10	"
General expenses	23.15	"
Other expenses	11.65	"
Total	100.00	"

The last portion of table No. 2 is a synopsis of table No. 1. Table No. 3 is the result of three tests made under the direction of the writer on a combined electric and lighting station, to ascertain the relative economy on oil and coal for fuel. Inasmuch as the information is quite complete, it has been thought advisable to insert it in this paper. The station consists of two compound condensing

TABLE No. 1.

	Direct Current.		Direct Current with Accumulators.			Alternating.
	Elberfeld.	Hamburg.	Barmen.	Hanover.	Dusseldorf.	Cologne.
GENERAL DATA.						
Fifty watt lamps capable of being supplied from the works	10,000.	11,600.	4,500.	12,000.	12,000.	13,600.
" " " " " " " " mains	12,000.	12,006.	6,500.	23,000.	23,000.	24,000
Available power in kilowatts	500.	580.	225.	600.	600.	680.
EXPENSES OF FIRST ESTABLISHMENT.						
Installation capital, in dollars	272,829.96	473,912.90	204,425.52	504,176.51	557,194.58	472,500.58
Specific expenditure, in dollars per kilowatt	545.25	816.93	908.50	785.70	926.35	693.55
" " " " " lamp	24.25	31 43	31.43	39.28	46.32	34 68
RECEIPTS AND EXPENSES.						
Duration of working, in years	5.	4.	5.	2.	1.	1.
Total receipts, in dollars	46,281.80	112,245.49	23,995,08	60,002.22	54,710 04	54,738 65
Receipts, per cent. of the capital	20.5	23.68	11.74	15.8	9 8	11.5
Total expenditure, in dollars	17,498.99	26,568.21	8,365.67	18,370.92	15,328.13	20,460.21
Expenditure, per cent. of the capital	6.41	5.62	4.9	4 46	2.72	4 07
Rough total profits, in dollars	28,782.81	85,677.28	15,629 43	46,621.30	39,381.91	34,278 44
Profits, per cent. of the capital	14.09	18.05	7.05	11.34	7.	7.2
EXPENSES—COST.						
Total energy in kilowatt hours, produced	313,438.	542,900.	114,996.	452,520.	484,111.	....
" " " " " distributed	305,794.	513,183.	122,026.	365,115.	337,285.	307,074.
Efficiency of the mains, per cent	97.5	94.5	84 16	80.67	69.68	....
Energy in watt hours per lb. coal, produced	....	148	194.	219.	185.	....
" " " " " " " distributed	....	140.	90.	181.	129.	71.
Salaries in cents, per kilowatt hour, produced	2.44	1.80	3.28	1.73	1.63	....
" " " " " " distributed	2.52	1.92	3.90	2.15	2.33	2.93
Cost per kilowatt hour in cents, produced	5.57	4.91	5.76	4.05	3 15	....
" " " " " " distributed	5.70	5.18	6 85	5.02	4 54	6 65
Mean selling price in cents per kilowatt hour, including all expenses	18 26	21.86	19 85	17.79	16.20	17 81
Charge without deduction for the kilowatt hour in cents	17 95	....	17.65	17.90	20.95	16.96
Price for cubic feet of gas, consumption above 3,000 cubic feet, cents	.11	....	.12	.105	.103	.081
CO-EFFICIENTS OF UTILIZATION—DURATION OF LIGHTING.						
Number of 50 watt lamps installed	11,100.	14,000.	7,325.	13,642.	16,623.	15,329.
Maximum power utilized in kilowatts	400.	462.	139.	415.	409.	325.
Ratio of power utilized to power available	0.80	0 79	0.61	0.48	0.51	0.50
Duration of lighting, in hours, per annum	569.	393.	325.	529.	419.	422.
EMPLOYMENT OF ACCUMULATORS.						
Energy expended for the charge, in kilowatt hours	....	....	59,573.	194,733.	279,506.	....
Energy furnished by the discharge, in kilowatt hours	....	....	42,584.	154,836.	216,561.	....
Industrial efficiency of the accumulators, per cent	....	....	71 5	79.4	77.5	....
Ratio of energy supplied by the accumulators to the total energy distributed, per cent	....	....	35.	42.4	62.	....
Loss in the accumulators, per cent. of the total energy distributed	....	....	14.	11.	13.	....

TABLE No. 3.—24 Hour Test on Coal.

	Av'rge Gauge Pres. Lbs.	Temperature. Feed Water.	Temperature. Escaping Gases.	Duration Hours.	Average Watts. Railroad Circuit.	Average Watts. Incand'st Circuit.	Average Watts. Arc Circuit.	Horse Power Electrical.	Horse Power Indicated.	Per Cent. Loss.	Total Fuel Lbs.	Total Combustible Lbs.	Cost Fuel.	Water Total Used Lbs.	Evaporation per Hour Lbs. Actual Evaporation.	Evaporation per Hour Lbs. From and at 212°	Per lb. Fuel Actual.	Per lb. Fuel Equivalent 212°	Com. H. P. 34½ lbs. water, hour 212°	Cost per compound horse power per hour fuel	Cost of fuel for period.	Total cost operations, includ'g labor.	Total cost fuel and labor per kilowatt hour produced.
											Coal												Cents.
Feb. 2.	125	116°	640°	5.8	39215	......	......	52.56	......	......	3264	......	Indiana block coal at $2 60 per ton.	20626	3536	4052	......	......	117.5	....	$3.72	$7.11	3.10
	....	128°	680°	1.5	34100	34650	9180	104.46	......	......	937	......		7019	4433	5082	......	......	147.3	....	1.27	2 28	1 85
	....	118°	......	2 5	41360	38940	24140	140.00	......	......	2502	......		16849	6522	7474	......	......	216.6	....	3.04	4.13	1.53
	....	116°	......	3.6	26620	27170	24140	104 46	......	......	2874	......		21028	5735	6571	......	......	190.5	....	3.79	5.33	1 87
Feb. 3.	....	110°	620°	5.8	2572	16611	8160	36.56	......	......	3952	......		27845	4774	5471	......	......	158.6	....	5 03	6.26	3.96
	....	116°	......	1.3	24640	16500	......	55.14	......	......	1049	......		4544	3409	3907	......	......	113.3	....	.82	1.40	2.52
	125	118°	......	3.1	40480	......	......	54.26	......	......	1019	......		14437	4559	5225	......	......	151.5	....	2 60	3.97	3.08
Entire run..	125	114°	635°	24	......	......	......	......	......	......	15597	13878	$20.27	112348	4680	5364	7.20	8.25	155.5	$.00543	$20.27	$30.48	2.45
24 Hour Test on Oil.																							
											Oil.												
Feb. 6.	125	126°	480°	6.5	29631	......	......	42.2	63.3	33.2	1912	......	C'st oil ⅌ gal. $.017805 Cost oil ⅌ lb. $.000253.	23896	3677	4184	......	......	121.3	....	4.98	8.80	4 31
	....	124°	......	1.0	32436	35420	9180	106.0	137.0	22.6	371	......		4944	4565	5195	......	......	150.6	....	1.03	1.81	2.13
	....	128°	520°	2.4	33573	39160	24140	128.0	158.0	19.0	1091	......		15244	6310	7180	......	......	208 1	....	3.18	4 19	1.58
	....	......	......	3.6	24192	27170	24140	100 0	130.0	23.2	1691	......		10364	5282	6011	......	......	174 3	....	4 04	5.58	2.03
Feb. 7.	....	116°	......	5.8	660	16500	9180	35.3	86.9	59.4	1992	......		23889	4096	4661	......	......	135.1	....	4 98	6.20	4.06
	....	124°	......	.2	23980	16500	9180	77 0	107.0	28.0	115	......		1648	5824	6627	......	......	192.1	....	.34	.40	2.50
	125	118°	......	4.2	33920	......	......	42.2	63.3	33.2	1398	......		14971	3551	4041		......	147.2	....	3.12	4.95	3.72
Entire run..	125	122°	......	24.	......	......	......	......	......	......	8570	......	$21.68	103956	4332	4930	12.13	13.80	142.9	$.006324	$21.67	$31.93	2.83
24 Hour Test—Park Co. Coal.																							
Feb. 14 and 15.	....	......	......	......	......	......	......	......	......	......	......	......		......	......	......	......	......	......	....	......	......	......
	....	......	......	......	......	......	......	......	......	......	......	......	$2.15 T	......	......	......	......	......	......	....	......	......	......
	....	......	......	......	......	......	......	......	......	......	......	......		......	......	......	......	......	......	....	......	......	......
	....	......	......	24.	......	......	......	......	......	......	16930	14271	$18.20	101854	4244	4829	6.016	6.846	140 0	$.005417	$18.20	$28.43	......

engines, coupled direct to a line shaft. This shaft runs two 90 kilowatt railway generators, two 16 kilowatt arc light machines, two alternating incandescent dynamos of 30 and 50 kilowatt capacity respectively, or a total capacity of 392 kilowatts. The station is considerably underloaded, delivering but 1,248 kilowatt hours.

Referring to table No. 3 it will be observed that the test began at 10.20 a. m., and continued for 24 hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kw hour.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5:50 a. m., and ran until 12 o'clock midnight, and the lighting load was added as indicated by the figure.

The division in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does, upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7:20 a. m. to 4:10 p. m., when the railway load is being operated, the cost averages 3.1 cents per kilowatt hour, and from 12 o'clock midnight until 5 a. m. the cost per kilowatt hour is 3.96 cents, while during the heavy load, from 5 p. m. until midnight, the average cost per kilowatt hour is but 1.75 cents, and after deducting the labor, which is a fixed charge, the total cost per kilowatt hour for full load is but $1\frac{1}{3}$ cents. After allowing for salaries, office expenses, loss in lines and depreciation in the plant, the figures show that this station is delivering current to the consumer for 6.4 cents per kilowatt hour, which corresponds fairly well with the figures given in table No. 2. With a little calculation we see that this plant could have furnished 681 additional kilowatt hours, or over 90 additional horse power in motors, for ten hours from 6 a. m. to 6 p. m., for an additional cost of but $9 for fuel, or at a cost of one cent per horse power hour, and as a price of two cents per horse-power hour can be obtained for motor work there would be an additional revenue of $9 per day added to this station, assuming that all the motors were running fully loaded.

As a matter of fact the following statement shows approximately the average amount of power demanded from electric motors when running on various kinds of work: Wood working machinery, 40 per cent. of rated capacity of machines in the plant; elevators, 80 per cent.; printing presses, 55 per cent.; machine shops, 40 per cent., or an average of about 55 per cent. On this basis this plant could drive safely 160 horse power in addition to its present railroad load, which, at 2 cents per horse power hour would bring an additional revenue of $33 per day, and deducting $9, the cost of fuel, leaves $24 per day additional net profit which this plant can be made to earn, provided the full capacity of the motors is paid for.

In case the additional load for electric motors is not available this extra 90 horse power could be utilized in driving an ice plant. In practice it takes about 2 horse power 24 hours to produce a ton of ice, and on this basis the available capacity of this plant would produce 20 tons of ice, which would sell for at least $3 per ton, making an additional revenue of $60 per day for the plant, and after deducting for extra fuel, labor and depreciation, leaves $40 per day profit.

The cost of ice-making plants is about as follows, per ton of output in 24 hours:

1 ton	$2,700
2 "	2,650
6 "	1,216
12 "	902
20 "	875
40 "	800

In closing this paper I will briefly call attention to the approximate results we are now getting from the different portions of power stations, and what we ought to expect from future stations.

First—Boilers—A large number of stations running now are using boilers with plain furnaces, from which they secure an evaporation of 5 pounds of water per pound of coal. By the introduction of water

TABLE No. .

	Station	H. P. Capacity.	Kilowatt Capacity	Hours Operated Per Day.	Watt Hours Per Day.	Coal. Kind Used.	Cost Coal Per Ton.	Watt Hrs. Per lb. Coal.	Cost Coal Pr. Kw. Hour.	Cost Other Exps. Kw. Hr.	Total Cost Per Kw. Hr. Del. to Customer.
									Cents.	Cents.	Cents.
Direct Current	1				604,600		$2.53	114.	1.11	4.94	6.05
	2				404,300		3.01	88.	1.10	4 06	5.76
	3				305,300		2.57	107.	1.20	5.16	6.36
	4				299,600		2.47	122.	1.01	4.72	5.73
	5				194,150						6.35
	6				140,000		2.55	108.	1.18	5.76	6.94
	7				126,700		3.15	53.	2.96	5.92	8.88
	8				105,700		1.94	71.	1.36	3 37	4.73
	9				85,100		1.42	65.	1.10	3.61	4.71
	10				53,700		2.20	53.	2.06	3.05	5.11
	11				50,300		82	48.	.85	5.07	5.92
	12				47,800				2.24	4.69	6.93
	13				37,100		2.26	82.	1.38	5.71	7.09
	14				33,600		2.38	66.	1.80	4.42	6.22
	15				33,400				.11		6.19
	Averages..	....	....	....	....	....	2.28	81.5	1.46	4 65	6.20
							Assumed.				
Direct Current	16	90.	67.045	24.	1,609,070	Bitm. Slack.	$1.50	150.	.50		
	17	25.	18.400	15.	276,000	" "	1.50	46.	1.63		
	18	37.	27.450	10.	274,500	" "	1.50	56.	1.34		
	19	17.	12.720	14.7	187,860	" "	1.50	64.	1.17		
	20	18.	13.420	6.5	87,230	" "	1.50	62.	1.21		
	21	20.	14.560	5.0	72,800	" "	1.50	40.	1.87		
	22	48.	35.650	7.5	267,375	Bitm. Block.	3.00	76.	1.98		
	23	33.	24.605	10.	246,057	" "	3.00	46.	3.27		
	24	20.	15.000	9.	135,000	" "	3 00	56.	2.68		
	25	20.	15.200	6.	91,368	Anthr. Pea.	4.50	65.	3.46		
	Averages..	....	....	....	....	....	....	66.	1.91		
Alternating Current	26	26.	19.000	8.	152,000	Bitm. Slack.	$1.50	104.	.72		
	27	295.	220.000	9.5	2,090,000	Indian Block	3 00	52.	2.89		
	28	66.	49.220	16.0	785,920	Bitm. "	3.00	121.	1.24		
	29	38.	28.000	12.0	336,000	" "	3.00	96.	1.56		
	30	30.	22.000	11.0	242,000	" "	3.00	76.	1.98		
	31	30.	22.300	14.0	312,666	Anthr. Pea.	4.50	108.	2.09		
	32	25.	18.480	6.0	110,880	" "	4 50	110.	2.05		
	Averages..	....	....	....	....	....	....	95 3	1.79		
Combined Systems	33	181.	134.780	21.0	2,843,760	Bitm. Block.	$3.00	104.	1.44		
	34	446.	332.150	24.0	7,971,600	Anth. Scrns.	1.50	208.	.36		
	35	32.	24 100	15.5	373,520	Bitm. Slack.	1.50	111.	.68		
	Averages..	....	....	....	....	....	....	141.	.83		
German Plants	Elberfeld	(direct current station)			313,438						5.70
	Hamburg	" " "			542,900			148.			5.18
	Cologne	(alternating current station)			307,074			71.			6.65
	Barmen	(direct current with accumulator)			144,996			104.			6.85
	Hanover	" " " "			452,520			219.			5.02
	Dusseldorf	" " " "			484,111			185.			4.54

tube or internally fired boilers or tubular boilers set in improved furnaces, we will secure an evaporation of 8 pounds of water per pound of the same fuel.

Second—Engine and Generators—While we now get an average commercial efficiency of 60 to 70 per cent. in direct belted plants and 50 to 60 per cent. in those using shafting, we can increase these efficiencies to 70 and 75 per cent. respectively by the adoption of fewer and larger direct coupled units. This will not only reduce the cost of fuel and labor, but will decrease the amount of real estate required and make the total investment less.

Third—While Europeans have recognized the advantage of the use of accumulators with batteries as auxiliaries in central station work, we have been slow to see this advantage, but the tendency now among American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein a battery plant as an auxiliary can be made to pay well, the probability is that we shall see in the next five years many such plants installed. With a properly designed direct connected plant we may reasonably expect to deliver a kilowatt hour to the consumer in stations having a capacity of not over 1,500 kilowatts for 5 cents per kilowatt hour, which includes total cost of production and depreciation on the plant, but excludes interest on the investment and profit, assuming that a good quality of bituminous coal can be had for $2.50 per ton. In larger stations with cheaper fuel the cost can be brought to 3½ cents.

Another Inoperative Unipolar Machine.

According to an illustrated description in a German contemporary, it appears that another German patent has been granted for a unipolar machine which will develop no current. Had the inventor read a recent article in The Electrical World he would have saved himself the expense of the patent and the embarrassment of finding out, after it is too late, that his machine is of no use. We recommend the German Patent Bureau to adopt the same plan that our Patent Office has found so very effective in these cases, which is simply to call for a working model before the patent will be allowed.

Treatment in Case of Accidents.

The publication of Dr. d'Arsonval's valuable "formula," namely that a man shocked by electricity should be treated as if drowned, has called forth other articles on this subject, among which is a recent one by a German doctor in one of our contemporaries. With genuine German thoroughness he states that the first thing to be done is to get a physician, then to treat the burns like any other burns, etc., adding that they are not generally dangerous. As we are mere laymen it may not seem proper for us to express any radically different opinions on medical matters, yet, being Americans, we venture to suggest that it would be far better to advise a person to send some one else for the physician, and meanwhile try at once to resuscitate the victim by artificial respiration, leaving the care of the burns to the undertaker, or to the physician if resuscitation is successful. Thoroughness is a good thing, but a little common sense is sometimes better.

Another Revolutionizing Railway System.

A consulting engineer informs us that an enthusiastic inventor came to him recently with the following idea: The rail for his street railway is made of a flexible band, and large electromagnets are placed behind each of the wheels, which, by their magnetic attraction, will raise up the rail behind each wheel, thus forming little hills down which the car will move by gravity, these little hills following the car as it travels along. As the rail neither advances nor recedes from the magnet, no power will be required other than a small amount of current to excite the magnets. He was told that his mistake was to come to an engineer with his project; he would no doubt be able to obtain financial assistance to form a large company to introduce his invention if he went to some of the many capitalists who do not believe in science or in the advice of an engineer. It was suggested to him that even the power for the magnets might be dispensed with if the flexible rails be made to pass over pulleys directly behind the wheels. It reminds us of a scheme for canal boat propulsion, due, we believe, to Mark Twain, in which the canal was made in the form of an inclined plane, down which the boats would slide by gravity; but, as that involves difficulties for the return trip, he improves it by making the boats themselves in the form of an inclined plane instead, and they would then slide down in any direction in which they were pointed.

Sine Form of Curves of Alternating E. M. F.

Our American contemporary, the Electrical World, recently discussed in an editorial note the question of the value of sine curves for the electromotive force of alternators. We have ourselves already remarked on this question, and have expressed our opinion, which we know to be shared by alternator experts in this country, that the elaborate attempts which are being made by some of the American alternator builders to give this property to their machines are utterly useless, and a complete waste of time and energy. Our esteemed contemporary, however, thinks differently, and bases its conclusions on the deductions of Kennelly and some experiments by Dr. Duncan on two-phase motors. It is, therefore, apparently supported by both theory and practice; yet, when we examine the matter a little more closely, we are by no means inclined to agree that our contemporary has sufficient grounds for its conclusions. In the first place, theoretical considerations, especially of the intricate phenomena of alternate current machinery, are apt to ignore those influences which, though difficult to put into exact mathematical form, are just the things which determine the truth or fallacy of the conclusions. Again and again this has happened, and it has been shown that mathematical inference, unsupported by experimental evidence or based on insufficient data, cannot be relied on.

It may, perhaps, be argued that the results of Dr. Duncan's researches afford this necessary experimental evidence. Let us see what these researches amount to. Dr. Duncan commences by observing that "the mathematical treatment is difficult, unless many essential phenomena are omitted." He then describes some experiments on a two-phase 2 h. p. Tesla motor. This motor was run from a 25 h. p. two-phase generator, which was believed to give practically a true sine curve of electromotive force. The results obtained were not compared with those which might have been obtained from any other alternator; they therefore stand alone. Moreover, the motor was not even run up to its full capacity, nor was it supplied with its rated electromotive force; so that it was "not, of course, particularly efficient." In all of which, we may ask, is there anything to show that the motor was more efficient than it would have been in any other case? Nor are the practical rules for design, which follow from these deductions, any more comforting to the builder of alternate current machinery. "To satisfy the condition in the armature would require an infinite number of armature windings, but it can be practically satisfied in the higher machines with a reasonable number of windings. It must not be understood that it is especially easy to accomplish this." So much for the true sine armature; as to the field windings, "projecting pole pieces should certainly be avoided." We should not be surprised to hear that the sine curve should be carefully avoided, and that the "best" curve is of a very different shape.—London Electrician.

An Experiment That Failed.

To the Editor of The Electrical World:

Sir:—I was somewhat interested in reading Lieut. Patten's last contribution on "An Experiment That Failed," as I myself designed a telephone repeater almost identical with Lieut. Patten's more than ten years ago, with just the same results. After a great many experiments, I succeeded finally in producing an instrument on altogether a different plan, of which it can be said that it was just as easy to carry on conversation over a long line with the instrument in circuit as without it.

Schenectady, N. Y. J. S. B.

The Measurement of Polyphased Currents.

To the Editor of The Electrical World:

Sir:—From a note by Prof. A. Blondel in the issue of your journal for July 28, 1894, it appears that a misunderstanding exists as to the paternity of the general formula which is quoted therein. Mr. Blondel also quotes my disclaimer to this formula and then construes it in a manner to make it appear quite the opposite of its obvious meaning and intent. The statement discussed means simply and only that to the writer the demonstration given by Mr. Blondel did not seem as natural as the one given, and that beyond the demonstration of Mr. Blondel the writer was not aware of any which was not limited to some consideration of the form of the circuits in which the energy was utilized. More explanation than was given did not seem necessary at the time the article was written. A comparison of the methods of Prof. Blondel and myself will show that they are not the same, the same final result being reached in either case, but in a different manner.

Washington, D. C. Alexander D. Lunt.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING

ELECTRO-PHYSICS.

Uni Directional from Alternating Currents.—A Royal Society paper by Major Cardew is published with illustrations, in the Lond. "Elec.," July 13. In making some tests of a high potential alternating current system of about 1,000 volts, he found that in all cases there was an apparent E. M. F. of 5 to 6 volts, tending to cause a flow of positive electricity to earth; a small copper voltameter showed the existence of a uni-directional current to earth. He explains the results by stating that when the cables were charged with positive electricity the polarization is sufficient during one alternation to considerably increase the resistance of the slight leakage to earth by the formation of a film of oxides; this obstruction is cleared off by the succeeding negative wave, which opens the leak, but the time of an alternation is quite insufficient to produce this effect on the water pipe earth and the result therefore is a passage of negative electricity to earth through the cables and of a corresponding quantity to earth by the water pipes.

Electricity and Gravitation.—A correspondent to the Lond. "Elec. Rev.," July 13, states that there are very strong reasons for believing that the ether obeys the ordinary laws of gravitation. "If we accept the notion that ether attracts itself, and obeys the ordinary laws of gravitation in regard to itself and to other forms of matter in a condensed form, then it is not difficult to understand its whole phenomena of disturbance."

Photo-Electricity.—"Cosmos," June 16, contains an article by Mr. Berthier, in which he gives a good summary of batteries or cells in which light is converted into an electric current directly; quite a number of devices are described, and in a few cases some quantitative data are given.

Photo-Electric Researches.—The Lond. "Elec.," July 13, contains a brief summary by Dr. Lodge of the researches of Mr. Righi.

Calculating Co-efficients of Self-Induction.—"L'Ind. Elec.," July 10, mentions a paper by Mr. Guye on the geometric distance between elements of an entire surface and its application to the calculation of the co-efficient of self-induction.

Production of Hail.—The theory of Mr. Marangoni, in which electricity is an important factor, is briefly abstracted in the Lond "Elec.," July 13.

MAGNETISM.

Froelich's Magnetic Law.—In an article by Dr. Froelich, in the "Elek. Zeit.," July 5, he calls attention to the law which he recently deduced (see Digest, Aug. 12, 1893, also Feb. 17, and The Electrical World, Feb. 24, p. 239), stating that he has since endeavored to verify it by experiments, obtaining good results, but finding that the calculated maximum flux was always smaller than that which had been found experimentally with high magnetizing forces. He concludes that the apparatus with which such measurements are usually made involves a number of errors when high magnetizing forces are used; he refers to those usually used in practice in which the iron is surrounded by a coil, its circuit being completed by an iron yoke; among them are: that the influence of the yoke, as also that of the contact surface, is not eliminated with sufficient precision; that the magnetizing coil has an action not only on the sample but also on the yoke, which action was not taken into account with sufficient precision; that the small test coil is affected not only by the flux through the iron sample, but also by that in the yoke and in the air space, and finally that the sharp ends in the iron give rise to leakage at high magnetization. In order, therefore, to test his formulas, he calculates a series of results and curves from the recent researches of Mr. Lehman, published in "Wied. Ann.," vol. 48, page 405, in which the method of Kirchhoff was used, which is free from the above named errors, and which, it may be safely assumed, gives the true magnetization curve; in this method a complete iron ring surrounded by the coil was used. Dr. Froelich gives his formulas, the deduced values of the constants and several tables of results and curves, showing the difference between the calculated and observed values, the agreement being a very satisfactory one; the above refers to his more complicated but more accurate formulas, and he therefore concludes that these formulas represent the true magnetizing law of iron; he finds from these results that the maximum flux is very much higher than was usually supposed, and furthermore, that it cannot be determined with any accuracy. He also applies his simpler approximate formulas to these results and finds that they are very reliable for magnetizing forces between $H=6$ and $H=40$ that is, for the range used in practice but that above and below these values they do not apply (it will be remembered that this was a straight line law); he concludes, therefore, that his simple formulas can safely be applied in practice, but that the value of the maximum flux which enters in them is not the true maximum, but is only an apparent one, and therefore has the character of a mathematical constant.

UNITS, MEASUREMENTS AND INSTRUMENTS.

The Arc as a Standard.—See abstract under "Rotation of the Electric Arc."

Specific Resistance of Pure Copper.—A Royal Society paper by Messrs. Swan and Rhodin is abstracted in the Lond. "Elec.," July 13. Great care was taken to obtain the purest electrolytic copper, only the best of a large number of samples being used and again refined electrolytically; the diameters were determined by the specific gravity method; the absolute specific resistance at 0° C. was calculated from the temperature co-efficients which were carefully determined; the density was 8.9587 at 15° C.; the specific resistance in C. G. S. units (presumably at 0° C., although not so stated) for one sample was 1,603 hard as drawn, 1,566 for the same sample annealed and 1,559 for another sample annealed; the temperature co-efficients were respectively 0.00408, 0.00418, 0.00415; he believes that the mean is the probable correct value, and gives the following as the true values: hard 1,603, soft 1,563; temperature co-efficients 0.00408 and 0.00416 respectively. (Attention is called by the compiler to the determinations of Mr. Lagarde, given in the Digest, Oct. 7, 1893, further references to the original being given in the Digest, Nov. 18, 1893, and March 17, 1894.)

Magnetic Curve Tracer.—According to an editorial in the Lond. "Elec.," July 13, Mr. Hess, before the French Academy, proposes to make use of the peculiarities of cathode rays pointed out by Dr. Lenard for obtaining a curve tracer with a pointer without inertia; cathode rays are made to fall on a rapidly moving photographic film, the whole "observing space," as Dr. Lenard calls it, being placed within the variable electric field to be investigated.

Measuring Co-efficients of Induction.—An Academy paper by Mr. Abraham, on the measurements and comparison of true co-efficients of induction by alternating currents of high frequency, is abstracted in "L'Ind. Elec.," July 10, and more fully in "L'Elec.," July 7; a Wheatstone bridge and telephone are used; the formulas for the relations are given.

Measuring the Efficiency of a Large Motor.—The article by Mr. Rey, mentioned in the Digest last week, is given in abstract in "L'Ind. Elec.," July 10

Meter.—The Brocq meter is described and illustrated in "La Lum. Elec.," July 7; a solenoid operates a float in a sort of dashpot, the motion of which is registered.

TRANSFORMERS.

Transformer System.—Mr. Whitcher, in the Lond. "Elec. Rev.," July 13, states that his method (see Digest July 28) is not as described in that journal; he does not, however, describe it clearly. He states that an extra primary main is used in place of an automatic switch, on the primary side as well as on the secondary, and that he disperses with all automatic mechanism, using only the same number of mains; for large sub-stations he proposes to use a method in which the currents in the two sides of the three-wire system can be varied in phase relatively to each other, from consonance through all values of oppositeness, by means of which the engineer at the central station can control the transformer capacity by the suitable alteration of the phase difference; he also speaks of controlling it by varying the induction in some of the transformers.

Constant Current Transformer System.—In a description of the Ferranti system in "L'Elec.," July 7 (see Digest, June 30, under "Portsmouth"), Mr. Meylan adds a theory of the action of such transformers, showing that it is questionable whether one can, by this means, obtain a true automatic regulator of the current and concludes that the construction depends on the limits between which regulation is to be effected.

Current Rushes in Transformers.—Mr. Hay's article is continued in the Lond. "Elec.," July 13; he discusses the effect of frequency and finds that the current rushes increase with the periodicity (that is, frequency). He then discusses experiments with inductive circuits containing iron and gives curves and tables; in a certain case the current rush was 6.74. In the same issue he replies to the comments of Dr. Fleming mentioned in the Digest last week, in which he states that the fact that his remarks applied to circuits without iron seems to have been overlooked by that critic, and hopes that his statements will have the effect of shaking the confidence in some of Dr. Fleming's conclusions.

ARC AND INCANDESCENT LIGHTS.

Projectors.—The "Elek. Zeit.," June 5, contains an article of some length by Mr. Nerz. He discusses at some length the various statements made in the discussion of the subject of photometry of projectors, which was published in The Electrical World last year; regarding Prof. S. P. Thompson's statement, he showed that according to that writer one square millimetre of crater has an intensity of 11.1 candles, while the present writer has obtained a maximum value more than ten times as great; he shows that with the large Schuckert search light at Chicago, on the assumption that the beam has an angle of 2 degrees, the theoretical point

from which the light appears to come will be only 43 metres behind the mirror, an error which can readily be neglected in applying the law of the inverse squares, as it is smaller than the errors in the photometric measurements. (Although he appears to consider the theory of the inverse squares to apply to projectors he gives no experimental proofs of its correctness, nor does he appear to intimate that such verifications exist.) To show that the mirrors of the Schuckert Company are a sufficiently close approximation to a true parabola, he describes three methods for testing the same; in one of these such a projector was compared directly with a Mangin projector, and it was shown that the parabolic projector was, in the worst case, 25 per cent. better and on an average 36 per cent. better; the results being obtained from tests made by several Government officials; in another case the calculated theoretical dispersion was compared with that from photometric measurements and it was found to be as 1 to 1.08, showing that the geometric form of the reflector is a very close approximation to the true parabola; the third method, that of Tschikoleff, is an optical one in which certain images are photographed. A large table is given, containing quite complete data for 8 different sizes of projectors, including the light giving power under various conditions; for a 60 cm. (about 24 inches) projector, with 40 amperes, the candle power is given as 24,900,000; the Austrian Government official, in a test, found it to be 20,000,000 at a distance of 2,050 metres, from which he deduces an absorption factor for the atmosphere, equal to 10.4 per cent. per kilometre, which he thinks is well within the probable value. Some simple theoretical deductions are given, from which a formula is deduced for the illuminating power on distant objects, as seen with the eye stationed at the projector; in an experiment made at the Gulf of Ismid with a 60 cm. projector, objects at a distance of 9.8 km. could be readily seen; he states that the absorption of the atmosphere may make a difference of from 2 to 50 per cent.; he shows that the former method of judging projectors by the discernment of objects as seen from the projectors is a very inaccurate one, and that theoretically an increase in this distance of 10 per cent. requires 50 per cent. more light from the projector.

Rotation of the Electric Arc.—A Royal Society paper by Mr. Trotter is published in the Lond. "Elec.," July 13; from experiments he finds that the effective luminosity of the arc is neither constant nor uniform; his experiments showed that a bright spot existed at or near the crater and that a periodic phenomenon accompanied its appearance, which, although more marked with short humming arcs, he believes to be present in all; under certain conditions he found that a bright patch, occupying one-fourth of the crater, appeared to be rapidly revolving; it consisted of a bright spot with a curved appendage, sweeping around in different directions; he attributes the phenomenon to the refraction of the light by the heated vapor; an unexpected difficulty is thus introduced in the use of the arc as a standard of light; he intends to ascertain the nature of the phenomenon and to find practical conditions under which it is absent or negligible.

Alternating Current Arc Lamps.—In the "Elek. Zeit.," July 5, Mr. Coerper criticises unfavorably the recent article of Messrs. Roessler and Wedding, abstracted in the Digest July 7, claiming that the results were obtained with old and abandoned types of machines and that no practical deductions should be drawn from them; he states that the Helios alternating current arc lamp has a hemispherical intensity below the horizontal of 498 candles with a consumption of 310 watts, corresponding to 1.6 candles per watt.

TRANSMISSION OF POWER.

Proposed Power Transmission Plant in Sweden.—The Lond. "Elec.," July 13, gives some preliminary information regarding a proposed plant for transmitting 20,000 h.p. over an industrial district and to a neighboring town by means of 15,000 volt alternating currents, it being a portion of the power of a waterfall amounting to about 49,000 h. p. and belonging to the Government; it is proposed to charge about $22 per h. p. per annum.

Alternating Current Transmission of Power.—"La Lum. Elec.," July 7, publishes a list of 31 installations, constructed or in course of construction, by Brown, Boveri & Co., in which single, di-phase or tri-phase currents are used; some data is given but it does not include distances.

Di-Phase Transmission of Power.—The article mentioned in the Digest June 9 and 23 is abstracted quite fully, with the illustrations, in "L'Ind. Elec.," July 10.

ELECTRIC RAILWAYS.

Roller Bearings for Railways.—A paper by Mr. Purdon is abstracted in the Lond. "Elec. Eng.," July 13; he describes tests showing a great saving of power in the use of roller bearings; in a test in which two trucks were started down a grade and continued on a level, the distances which they ran were as 6.39 to 1 in favor of the roller bearings; a similar result was obtained in a starting test; he calculates the savings in per cent. in the use of roller bearings, for various grades, the results varying from 15.2 per cent. on a grade of 1 in 20, to 50.7 per cent. on a grade of 1 in 140; he assumes a frictional resistance of 25 lbs. per ton for the ordinary bearings and 4.2 for cars fitted with roller bearings in accordance with the results of the experiments; he gives the extra cost of these bearings at about $50 per axle, which, however, might be reduced for large quantities.

Lyons Tramway.—A descriptive article is begun in the Lond. "Elec. Rev.," July 13; although not so stated it appears to be a translation from the French article of Mr. Berthon, mentioned in the Digest June 30 and July 14.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Gas vs. Steam for Central Stations.—Mr. Threlfall, in the Lond. "Elec. Eng.," July 13, calls attention to serious discrepancies in the article mentioned in the Digest last week, claiming that if corrected the results would prove that the gas plant will be very considerably more economical, both in first cost and in working cost.

The Cance Rheostat.—A translation of the description of the rheostat mentioned in the Digest last week is contained in the Lond. "Elec. Eng.," July 13.

Central Stations.—The "Elek. Zeit.," July 5, abstracts at considerable length, including a number of tables of data, from the report on the running of the Cassel station for the year ending March, 1893. The alternating current station in the city of Caen, France, in which sub-transformer stations are used, is described and illustrated in "L'Elec.," July 14. An illustrated description of the Burton station is published in "Ind. and Iron," July 13.

WIRES, WIRING AND CONDUITS.

Ship Wiring.—According to the large number of replies published in the Lond. "Elec. Rev.," July 13, the system described in that journal and abstracted in the Digest last week does not appear to be new, as a number of the correspondents claim to have used it for a number of years, Siemens Bros. & Co. having used it on 53 vessels. It is stated that great care must be taken to avoid low insulation of the distributing boards; one of the correspondents explains in detail the construction which he uses, a sheet of rubber being used for insulation; another writer thinks that the estimate of 10 per cent. for the excess in the cost of the wire is rather low, his experience being that it is about 15 per cent. higher; another claims that it requires an enormous quantity of cable compared with the single or double wire system, but he thinks it well worth the extra expense.

In an article by Mr. Leroy in "L'Elec.," July 7, an abstract of which is published in the Lond. "Elec. Eng.," July 13, he discusses the merits and demerits of the insulated and the ship-return systems, concluding in favor of the latter, at least for the iron vessels of commerce, if not for the war vessels.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Cable Telegraphy and Telephony.—In an editorial in the Lond. "Elec. Rev.," July 13, a reply is made to a recent editorial in The Electrical World in referring to Dr. Pupin's system; the tone of the editorial is decidedly more moderate than its former criticism; the remarks were based chiefly on the results of numerous experiments which have been made during several years by the British Postal Telegraph Department upon Wheatstone automatic fast speed working; it was found necessary to introduce repeaters, so as to bring the working "K R" within the necessary limits for high speed; a large number of trials were made with shunted condensers to see whether this would not enable fast speed working to be obtained without the use of repeaters, but it was found that the tendency of such contrivance was to reduce and not to increase the working speed; it was added that although the arrangements were much on the same lines as those indicated by Dr. Pupin, it was possible that certain of the combination suggested by him were not used; the Editors add that they hope they have been mistaken in their estimate of it.

Subscribers' Telephones Without Batteries.—A system of Mr. Merino, of Madrid, in which no battery is required at the subscribers' end of a telephone line, is described briefly in the "Elek. Zeit.," July 5. Instead of sending the battery current through the microphone and the primary induction coil, the telephone being connected with the secondary and line, the line is connected with the microphone and the primary coil, while the telephone is connected only with the secondary coil, the battery being then placed at the central station; in this system it is very easy to make the connections between the subscribers' and the central stations, as well as among the subscribers.

Time Distribution.—According to the "Elek. Zeit.," July 5, a company is about to start a regular time distribution system in Berlin, in which ordinary well regulated clocks are used and are set from a central station every four hours; the rentage of such a clock will be 50 cents per month.

Telephote.—"Cosmos," June 23, contains an article by Mr. Rabourdin, in which he describes the principle of an apparatus for transmitting light, as for instance, the form of a moving figure, to a distance, by means of an electric current.

Pacific Cable.—Mr. Alexander Siemens has made an offer to the Canadian Government to lay a cable from Victoria to Sydney within three years; his offer is now being considered. A brief report of the Ottawa conference is published in the Lond. "Elec. Rev.," July 13, giving, however, nothing of importance.

Atlantic Cables.—According to the "Elek. Zeit.," July 5, only 7 out of the 17 cables which have been laid across the Atlantic, are in use, the remaining ten, which have been abandoned, represent a capital of about thirty million dollars.

Telegraph Cable in the St. Gothard Tunnel.—The Lond. "Elec. Eng.," July 13, abstracts the descriptive article mentioned in the Digest March 31.

Compensating Cables.—A large number of systems, devised by Prof. S. P. Thompson, are illustrated in "La Lum. Elec.," July 7.

ELECTRO-CHEMISTRY.

Extraction of Gold and Silver.—According to the Lond. "Elec. Rev.," July 13, Mr. Trug is said to have greatly facilitated the extraction of gold and silver from their ores, by a method which depends partly upon centrifugal force and partly on amalgamation; a distributing disc throws out the sludge in such a way that the particles of metal are collected in an annular trough filled with mercury, the surface of the mercury being kept sufficiently active by connect ng that metal with the negative pole, and the tube for feeding the sludge to the disc with the positive pole of a current generator.

Electric Tanning.—"Ind. and Iron," July 6, states that the installation at Orbe, Switzerland, in which the Groth system is to be used, has now commenced working with a weekly output of 300 hides; it is considered a model of its kind in many respects; a complete illustrated description is promised; the report of Prof. Unwin on tests with such leather, mentioned in the Digest Jan. 27, is given.

Pickling.—The Lond. "Elec. Rev.," July 13, mentions a method which is claimed to do the work much more certainly and with less danger to pitting the surface; the articles are made the positive pole of a battery, the negative pole of which is either carbon or wire gauze electroplated with silver and covered with platinum black; the bath consists of dilute sulphuric acid containing a depolarizer such as a nitrate or chromic acid.

Aluminium.—In a note in "La Lum. Elec.," July 7, Mr. Moissan calls attention to the fact that the greatest obstacles in the development of the aluminium industry are the impurities in the metals; aluminium dissolves a quantity of carbon which is much greater than was formerly supposed and forms a perfectly definite carbide, having the property of decomposing water and evolving methylene gas; nitrogen also possesses great affinity for aluminium.

Aluminium Plating.—The system of Van Aubel is described briefly in "La Lum. Elec.," July 7; he first covers the aluminium with a scarcely visible coating of copper, after which the ordinary silver, nickel, etc., baths may be used; sulphate of copper and a current from a Grove cell are used for the copper coating, no special precautions being necessary.

Minimum E. M. F. Decomposition.—In an editorial in the Lond. "Elec. Rev.," July 13, the statement of Bertholet, made in 1882, is given, and is claimed to have been confirmed by the more recent experiments of Leblanc and Nourrison; he states that "the minimum electromotive force required to decompose an electrolyte is the sum of the heat absorbed by the separation of the acid from the base in dilute solutions, and the heat of decomposition into oxygen and hydrogen of the water by which the acid and the base are dissolved, provided that the acid and the base are neither oxidized nor reduced, and that the electrodes are not attacked." Bertholet's conclusion is independent of any theory of dissociation into ions.

Electrolytic Decomposition of Water.—The Lond. "Elec. Rev.," July 13, mentions some recent articles in the German on this subject.

Electrolysis of Alkaline Chlorides.—The E. M. F. for decomposing sodium chloride, calculated by Nourrison, is stated in the Lond. "Elec. Rev.," July 13, as being 2.02 volts, while the figures of Mr. Oettel are 2.30; the method of calculating each is given.

Faure's Patent.—A continued article by a patent solicitor is published in "Ind. and Iron," July 6 and 13.

MISCELLANEOUS.

Electricity in Therapeutics.—The Lond. "Elec. Rev.," July 13, abstracts a paper on the recent researches of Debedat, in which the application of electricity for stimulating the nutrition of the muscular system is experimented upon scientifically; the results are given and show in some cases a gain of 40 per cent. in the weight of the muscle due to certain applications of the current, while in other cases there was either no effect or else an injurious one. He concludes that the most advantageous mode of promoting the healthy growth of the muscles is to use an induction coil and to arrange the periods of contraction and repose so as to approximate to the conditions of a muscle during the performance of rhythmic gymnastic movements, namely about 30 periods; prolonged tetanization is extremely hurtful, showing that the methods most commonly used by ill-informed practitioners and worse informed quacks are entirely wrong.

Electrical Treatment of Tic-Douloureux.—A method of treatment is described in the Lond. "Elec. Rev.," and "Elec. Eng.," July 13.

What to Do in Case of Accidents.—"L'Ind. Elec.," June 10, contains an article by Mr. Claude in which he calls attention to the importance of instructing persons not only how to treat those injured by an electric shock, but more particularly how to remove such victims from the circuits when such circuits are still alive; he cites cases in which a second death was caused or nearly caused by the prevailing ignorance as to how such victims should be handled; he points out the danger of touching the body except through the medium of some insulating material and suggests first taking off some of one's own clothes and wrapping them around the hands, or of making a bundle of such clothes and forcing them between the victim and his connection with the earth.

Educational.—A report of the recent meeting of the London Technical Education Board is published in the Lond. "Elec.," June 29; the same number contains an editorial on the subject of education. A reference to education is also made in the editorial on electro-chemistry in the same issue; attention is also called to the first part of a paper by Prof. Ostwald in the "Elec. Zeit.," June 14, abstracted in the Lond. "Elec.," June 29. According to the Lond. "Elec. Eng.," June 22, chairs of electro chemistry are to be founded in the Polytechnic Academies of Berlin, Hanover and Aix-la-Chapelle.

Killed by Electricity.—Another accident is reported in the English journals; an attendant at an installation was instantly killed by an alternating current of 2,000 volts.

Elevators.—"La Lum. Elec.," July 7, gives an illustrated description of the inclined plane elevator at Marseilles in which two cars are connected by a cable, the descending one being weighted with water, so as to produce an overbalance, the water being pumped up by means of a pump; the description is interesting but the only electrical feature seems to be the indicator of the water level in the tank. In the same issue a number of electric elevators are described and well illustrated.

Electric Steering Compass.—According to the Lond. "Elec. Rev.," July 13, an apparatus of the same kind as that mentioned in the Digest June 2 and 30 was used in 1881 and worked perfectly; the invention did not come into general use because it would not pay, as some one has to stand by to keep a lookout, and might as well be steering.

Electrical Steam Cut-Off.—An automatic variable steam cut-off operated by electricity is described and illustrated in the Lond. "Elec. Eng.," July 13.

Consulting and Contracting Engineers.—The leading editorial in the Lond. "Elec. Rev.," July 13, discusses again the inadvisability and incompatibility of contracting engineers posing and acting as consulting engineers, considered from the point of view of the purchasers. It calls attention to the fact that some of the responsible firms will not bid for work when a contractor, who at times may be their competitor, is acting as a consulting engineer, in which case the purchaser suffers. By the formation of a strictly professional institution as suggested, to which only purely professional gentlemen could belong, the purchasing public would then know that they were not committing their interests into incompetent hands.

Cataloguing Literature.—A correspondent to the Lond. "Elec.," July 13, suggests that the international cataloguing of scientific papers might be greatly facilitated if it became customary for the author of a paper to conclude it with an abstract drawn up according to certain prescribed rules; he also proposes that the introduction of the custom might be facilitated if scientific societies and periodicals should make it a rule that every paper should be accompanied by such an abstract.

Biographical.—The death of Carl Grawinkel is announced. He was well known in connection with the work of the German Telegraph Department; also of Paul Lemonnier and Pierre Houry.

Prizes.—"L'Ind. Elec.," July 10, publishes a list of the prizes offered by the Industrial Society of Muelhause for the year 1895, pertaining to electricity.

Moonlight Tables for September, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of September under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	7.00 P. M.	2	4.30 A. M.	1	7.00 P. M.	2	4.30 A. M.
2	7.00 "	3	4.30 "	2	7.00 "	3	4.30 "
3	7.00 "	4	4.30 "	3	7.00 "	4	4.30 "
4	7.50 "	5	4.30 "	4	7.00 "	5	4.30 "
5	8.20 "	6	4.30 "	5	7.00 "	6	4.30 "
6	9.10 "	7	4.30 "	6	6.50 "	7	4.30 "
7	10.00 "	8	4.30 "	7	6.50 "	8	4.30 "
8	10.50 "	9	4.40 "	8	6.50 "	9	4.30 "
9	11.50 "	10	4.40 "	9	6.50 "	10	4.40 "
10	—		—	10	6.50 "	11	4.40 "
11	12.50 A. M.	11	4.40 A. M.	11	6.50 "	11	12.00 M.
12	1.50 "	12	4.40 "	12	6.40 "	12	"
13	3.00 "	13	4.40 "	13	6.40 "	13	"
14	No light.	14	No light.	14	6.40 "	14	"
15	"	15	"	15	6.40 "	15	"
16	6.40 P. M.	16	7.40 P. M.	16	6.40 "	16	"
17	6.40 "	17	8.10 "	17	6.40 "	17	"
18	6.40 "	18	8.40 "	18	6.30 "	18	"
19	6.30 "	19	9.10 "	19	6.30 "	19	"
20	6.30 "	20	9.50 "	20	6.30 "	20	"
21	6.30 "	21	10.50 "	21	6.30 "	21	"
22	6.30 "	22	11.50 "	22	6.30 "	22	"
23	6.30 "	24	1.00 A. M.	23	6.30 "	24	1.00 A. M.
24	6.20 "	25	2.20 "	24	6.20 "	25	2.20 "
25	6.20 "	26	3.30 "	25	6.20 "	26	3.30 "
26	6.20 "	27	4.50 "	26	6.20 "	27	4.50 "
27	6.20 "	28	4.50 "	27	6.20 "	28	4.50 "
28	6.20 "	29	5.00 "	28	6.20 "	29	5.00 "
29	5.20 "	30	5.00 "	29	6.20 "	30	5.00 "
30	6.20 "	1	5.00 "	30	6.10 "	1	5.00 "

Total No. of hours, 176.10.

NOTE.—These schedules are made up on sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

New Books.

ALTERNATING CURRENT WIRING AND DISTRIBUTION. By William Le Roy Emmet, Member A. I. E. E. New York: The *Electrical Engineer*. 1894. 76 pages, 29 illustrations. Price, $1.00.

The object of this work, the author states in his preface, is to point out the practical significance of some of the laws governing the distribution of alternating currents, and to explain these laws in such a manner that their nature and relative importance may be realized by practical men without the expenditure of time necessary to the study of complete works on the subject. To this end mathematical expressions and scientific terms have been avoided as much as possible, and the hope is expressed that the book may help the reader to form certain ideas and conceptions which will tend to make more available to him the information obtainable from more thorough and comprehensive works. The competency of the author, who is chief engineer of the General Electric lighting department, to execute the plan thus outlined is unquestionable, and in many respects the book is one of the most satisfactory yet written on the practical side of alternate current working.

In the first section of the book the various influences affecting alternating distribution are defined and explained. The section on skin resistance is very satisfactory and accompanied by a useful table. The next seven sections treat of inductance and impedance, one of which—on diagrammatic representations—explains very clearly the relation between resistance, reactance and impedance. Three sections follow on lag angles and load factors, and the next section is on line inductance, accompanied by a curve and two tables, one of resistance, inductive reactance and impedance for non-inductive loads, and another of the same quantities as influenced by a power factor of .96.

Four sections on practical diagrammatic and arithmetical determinations of the distribution of E. M. F. in an alternating circuit are admirable and by far the best practical treatment of the subject with which we are acquainted. The factors due to resistance and inductance in the primary and secondary circuits and transformers, and core losses in the transformers for given cases, are calculated or assumed and then combined by a simple but elegant method which at the same time enables the reader to grasp the entire subject of alternating effects better than a volume of disconnected explanations The treatment of multiphased systems in four short sections is entirely too condensed to be useful to the beginner, and those on distribution are an engineering discussion of the subject that seems out of place in a work of this character. Two of the final sections are on the effects of capacity, which seem rather misplaced, as they should logically come in the first part of the book devoted to impedance. The framework of the book, in fact, is sufficient for a large treatise, and much is lost by the effort to limit its extent.

We regret to note the very loose nomenclature of the author. The effective component of the impressed E. M. F. is called indiscriminately the energy component and the effective E. M. F., while the reactive component is variously called the inductive component, the inductance component and the induction component; in one table inductance component is used, and in an exactly similar table, induction component. Resistance proper or ohmic resistance in some places is resistance simply, and in others is called energy resistance, while inductive reactance is throughout called inductive resistance, and capacity reactance both capacity resistance and condenser resistance.

To the student the work will furnish a useful introduction to the study of alternating current phenomena, although he will find some sections difficult reading from the exceedingly condensed style in which they are written. With the exception of several sections (which, however, will be worth the price of the book to many), the practical man will, we fear, find the work too general in its treatment and the statements too academic in character for the book to be of full use to him. In this respect the paper of Mr. Scott, read at the Washington convention of the National Electric Light Association, comes much nearer to meeting his wants. To the electrical engineer, however, notwithstanding the elementary nature of some of the matter, the work will be found of much value, particularly the part discussing electrical distribution, the sections on alternating circuit calculations, and the several tables of data.

THERMODYNAMICS OF REVERSIBLE CYCLES IN GASES AND SATURATED VAPORS. Full synopsis of a ten weeks' undergraduate course of lectures delivered by M. I. Pupin, Ph.D. Arranged and edited by Max Osterberg, student in electrical engineering, Columbia College. New York: John Wiley & Sons, 1894. 114 pages, 10 illustrations. Price, $1.25.

The course of lectures collected in this volume forms a theoretical introduction to a practical course on heat engines, and is limited to a discussion of those features of theoretical dynamics which have a direct bearing upon the science of caloric engines.

While the treatment of the subject is a mathematical one, the physical basis of the science, unlike in many works on thermodynamics, is constantly kept in view. Instead of the general equations being assumed or built up from assumptions, the student has the physical significance of each term and of each deduction impressed upon him. The numerical calculations in different sections of the book are a good feature, and the discussion of Carnot's principle with reference to an actual indicator is to us an innovation, though a commendable one. The answer to the question why the prevailing types of steam engines differ so widely from Carnot's type in efficiency is to be recommended to those who will wail over the sinful waste in the former. We may remark that the excessive use of italics in the text gives an impression of weakness as to literary style of the author which a close examination shows is far from deserved. For a college course, whose object in teaching thermodynamics is to prepare for the study of practical heat engines, this work may well be adopted as a text book.

A New Telephone Transmitter.

A novel resistance piece for telephonic transmitters, recently patented by Mr. Herbert Cottrell of Newark, N. J., has for its main feature a construction such that there is an unbroken connection through it in all conditions of the instrument, and a second connection parallel with the first, which latter is opened and closed or varied in resistance by vibrations of the diaphragm of the transmitter. This is done by provid-

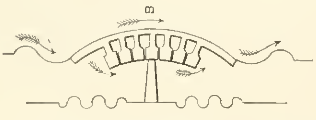
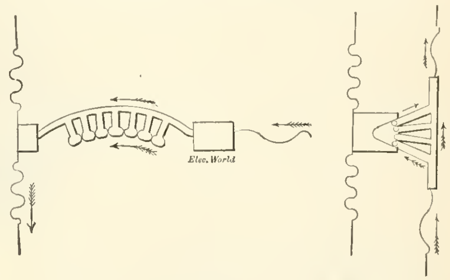


FIG. 1.—TELEPHONE TRANSMITTER.

ing a strip or rod of some conducting material, as a thin strip of carbon or of some carbonaceous substance, from which project knobs or points that are but lightly if at all in contact with each other when the strip is straight, and are brought more or less intimately in contact through the operation of the diaphragm. These projecting points or knobs on the strip may be brought together by flexure of the strip or may be crowded together by being pushed against the walls of a cone which fits over the



FIGS. 2 AND 3.—TELEPHONE TRANSMITTER.

points or knobs and cams them together. The flexure may be produced by pushing and pulling on a knob or point or on the rod or strip; and instead of flexure which operates to bow a flat strip the operation may be to twist a rod, around the periphery of which knobs or projections of suitable shape are arranged, preferably in a sort of spiral. This latter is called the torsional form.

As to the material, any suitable substance of large electrical resistance may be used, carbon or some preparation of carbon being preferable; as, for example, manilla paper carbonized by the process used to prepare

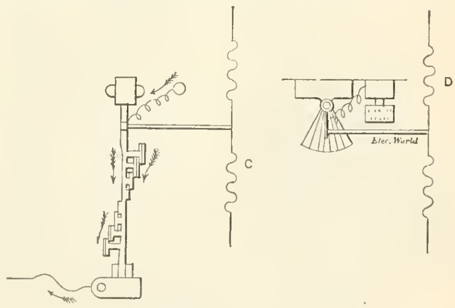


FIG. 4.—TELEPHONE TRANSMITTER.

the filament of the familiar incandescent lamp. The whole constitutes a resistance piece of which the rod or strip is the base and the knobs or points are the projections. The telephonic circuit may be of any of the forms which are adapted to use with a variable resistance.

Referring to the illustrations, Fig. 1, A, B, shows the resistance piece, the arrows indicating the path of the current in its flat and in its bowed condition. Fig. 2 shows another way of bowing the strip. Fig. 3 shows the method of camming the projections together. Fig. 4, C and D, shows the torsional form.

As will be seen from the inspection of any one of these illustrations,

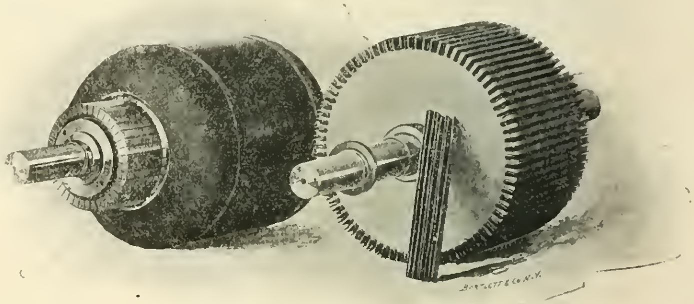
no movement of the diaphragm can rupture the circuit, since that is always complete through the base of the resistance piece, along which the variable contact shunting projections are arranged; obviously, the resistance will be greatest when the circuit is completed only through the base of the resistance piece. For, if the projections are brought in contact, there is then established, in addition to the circuit through the base, a circuit through the contacting projections, which shunts that portion of the strip or rod that lies between the points at which these projections join the base. The resistance of the projections is preferably considerably smaller than the resistance of the base along which they are set.

It is very important, particularly in long distance telephony, that the line should never be broken, no matter how violent may be the vibration of the diaphragm. This point of advantage is secured, it is claimed, as above explained, since separate electrodes held in contact with each other, the pressure between which is varied by movements of the diaphragm, are not used. Then, too, the fact that there are a number of points in contact is of advantage, because, even though the sound may be violent enough to throw two or more of them out of contact, it still may not throw all of them out of contact. Doubtless the mere flexure or twisting of the base of the resistance piece itself produces some variation in its resistance, and consequently in the resistance of the circuit. But it is the effect of shunting the sections of the base that is relied upon.

Manchester Type Slow Speed Motor.

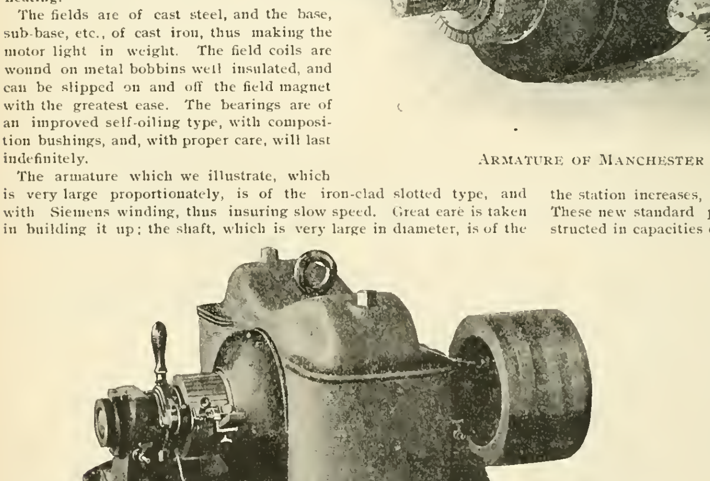
The Manchester type of field in dynamo and motors has been used with much success in this country and in Europe, where it originated. It is both magnetically and mechanically symmetrical, the armature comes nearer the base than in many other types, and the completed machine has a compact and mechanical appearance. The motor of this type we illustrate is made by the Mather Electric Company, Manchester, Conn., and by careful design the makers have produced a machine not only highly efficient but one in which sparking at the commutator will not take place under any change of load or condition, and which can be operated indefinitely under full load without any danger from heating.

The fields are of cast steel, and the base, sub-base, etc., of cast iron, thus making the motor light in weight. The field coils are wound on metal bobbins well insulated, and can be slipped on and off the field magnet with the greatest ease. The bearings are of an improved self-oiling type, with composition bushings, and, with proper care, will last indefinitely.



Armature of Manchester Type Slow Speed Motor.

The armature which we illustrate, which is very large proportionately, is of the iron-clad slotted type, and with Siemens winding, thus insuring slow speed. Great care is taken in building it up; the shaft, which is very large in diameter, is of the best machinery steel; the core is of sheet-iron discs, which, by an improved Mather annealing process, together with a proper proportioning of wire, does away with any destructive heating. For the insulation throughout mica is used exclusively. The armatures are carefully balanced before being sent out, and will operate without any vibration.



Manchester Type Slow Speed Motor.

The commutator is of improved design, massive in form, and carefully insulated. Pure lake copper drop-forged bars are used exclusively, which, although more expensive than those of cast copper, insure the absence of blow holes and black spots, and a smooth running and long-lived commutator. Every part of the motor is made to jigs and templets, and any part can thus be duplicated at once from stock.

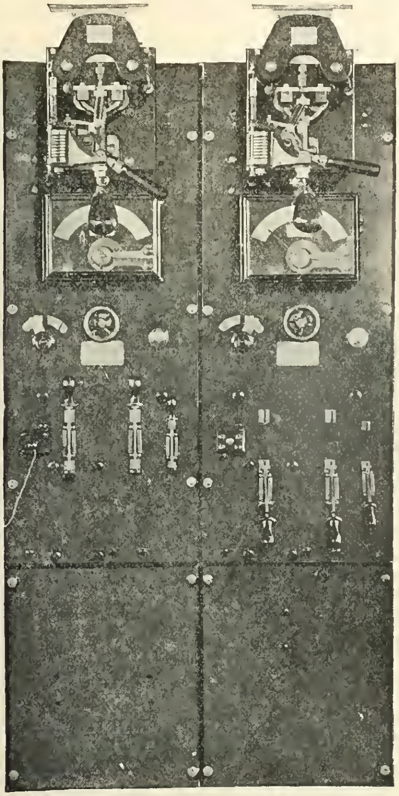
Railway Generator Switchboard Panel.

In order that the switchboards of electrical railway stations may be of uniform construction, handsome in appearance, and generally a credit to the station, a departure from hitherto accepted methods is necessary. We described a short time ago a feeder panel of the General Electric Company's make which fulfilled the electrical and æsthetic requirements, and we now show a generator panel made by the same company constituting with that just mentioned the departure in question.

Briefly, the system of switchboard construction, while becoming greatly simplified, is rendered very compact and convenient. All the instruments necessary for the control of each generator are mounted together on an incombustible base and are electrically connected before leaving the factory. Each panel may be erected in position without difficulty or delay. Being of uniform size it may be bolted by the side of other panels already in place, and the switchboard extended, as the capacity of the station increases, without at all taking away from its uniformity. These new standard panels are known as type "K," and are constructed in capacities of from 200 to 3,000 amperes, corresponding to the generator outputs of from 100 to 1,500 kilowatts. The controlling devices mounted upon each panel are the circuit breaker, current indicator, rheostat, main, field, and lighting switches, together with the lightning arrester and cutouts required for the protection of generator and instruments. A double pole plug switch allows of connection with either a portable or station voltmeter placed in some convenient position. The panels, of from 200 to 1,000 ampere capacity, are of the same width and height, and, in the latter dimension, are similar to the feeder panel. The illustration shows two panels of 400 amperes each.

The automatic circuit breaker is intended to relieve the generator of the severe strain caused by short circuit. The tripping armature is fitted with an adjustable spring whereby the circuit breaker can be set to open at any desired point within the range of the instrument. The current is nominally carried through a main contact in shunt to a contact operating within a magnetic blow-out. Thus, when operating, no arc occurs at the main contact. This circuit breaker will effectually rupture any short circuit, however severe. The armature is provided with a scale 18 inches long, which may easily be read at a distance. The positive and negative main switches and the station lighting switch, all of the quick-break type, are mounted on the panel, the equalizing switch being mounted on a pedestal near the generators. In the lightning arrester the special fea ure is an iron clad electric magnet, in the field of which are two carbon points slightly separated, the line and

ground each being connected to one of these points. The magnetic blow-out principle, as in the automatic circuit breaker, is here employed with unvarying reliability. The incombustible controlling rheostat is placed behind the board, and is operated by a hand wheel shown on the front. The generator terminals are connected by a small four-point



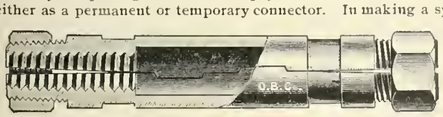
RAILWAY GENERATOR SWITCHBOARD PANEL.

plug switch with an illuminated dial voltmeter mounted on an adjustable bracket fastened near the top of the panel.

The panels are supported by vertical angle irons, tie rod and brackets. They are wired complete, and after setting in place it is only necessary to connect the leads from the generators and bolt in place the bus bars.

Feeder Wire Splicer.

This device, which was brought out last year by the Ohio Brass Co., of Mansfield, Ohio, was the first practical one of its kind, and has met with almost universal approval from construction men. Besides making a practically perfect joint in the feeder wire, it saves enough time over the ordinary way of splicing to more than pay for its first cost. It can be used either as a permanent or temporary connector. In making a splice,

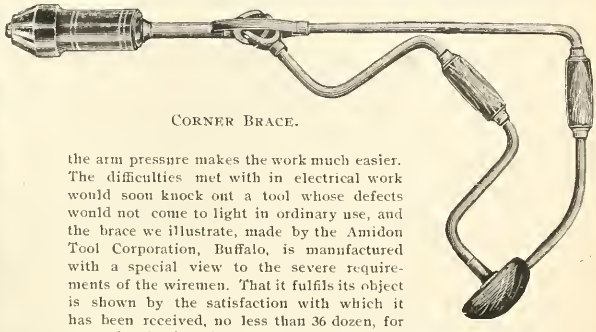


FEEDER WIRE SPLICER.

the insulation is first removed and the halves of the splicer are placed over the abutting ends of the bare wire. The nuts are then screwed on the tapered ends of the splicer, which is slightly corrugated on the inside, thus securely clamping the wire. Solder can be poured through a slot provided for this purpose. A joint made in this way is but a trifle larger than the wire, and is of low resistance and great strength, the average electrical resistance being about .02 of an ohm, and the mechanical strength of the joint being more than that of the wire itself.

Wireman's Corner Brace.

One of the most essential tools of the electric wireman is a good corner brace. The ratchet brace otherwise used for his purposes is not only slow and tiresome to work with, but the bit is apt to become loosened in the backward motion, particularly in hard wood. The corner brace will bore holes close into the corner—more than an inch closer in than the ratchet—and will do it twenty times faster. For work in the clear it is not only faster than the ordinary brace, but the straight rod guides the eye so that the bit goes in absolutely straight, and the power gained by



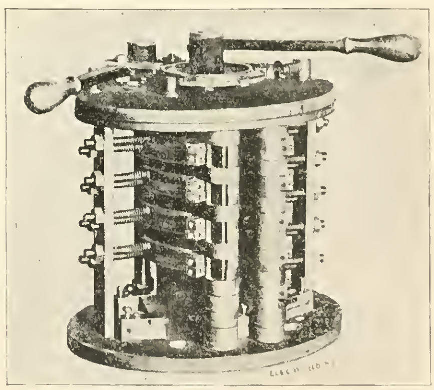
CORNER BRACE.

the arm pressure makes the work much easier. The difficulties met with in electrical work would soon knock out a tool whose defects would not come to light in ordinary use, and the brace we illustrate, made by the Amidon Tool Corporation, Buffalo, is manufactured with a special view to the severe requirements of the wiremen. That it fulfils its object is shown by the satisfaction with which it has been received, no less than 36 dozen, for example, having been used in electrical contruction work at the World's Fair. The tool is graceful in shape, the rods are of steel, and particular attention has been paid to finish, all of the metal parts being heavily nickeled.

Electric Launch Battery Controller.

The controller illustrated herewith was designed by the Cutler-Hammer Mfg. Co., 241 South Jefferson street, Chicago, for use in the four beautiful electric launches purchased by the commissioners of Lincoln Park of parties having the electric launch concession at the World's Fair. It was found that the controllers used for regulating the speed of these launches were unsatisfactory and the Commissioners therefore awarded to the Cutler-Hammer Mfg. Co. a contract for designing and manufacturing an efficient combined reversing device and speed controller, which is shown in the cut.

The device is a model of compactness and consists of an upright cylinder eight inches long, with properly arranged segments to give the



ELECTRIC LAUNCH BATTERY CONTROLLER.

desired speeds, three in number. The segments are connected with the batteries by means of five sets of brushes held to their place by readily adjustable springs. The brushes are so arranged that they can be removed with the greatest possible ease, and all parts are very heavy and substantial to stand the abuse generally received by this sort of apparatus.

The cylinder is operated by a brass lever, to which is attached a cam that engages with a stop in such a manner as to indicate, both to sight and feeling, when the cylinder has rotated to the proper position for each speed. The reversing device is operated by a similar lever and the arrangement is such that it is impossible to reverse the motor without first revolving the cylinder back to "full off," but the reversing handle may be used to open the main circuit instantly with the controller in any position.

Attractive Power of the Stomach.

An electrical society in Vienna makes use of a well known truth in deciding that during the summer months the informal meetings of the society will take place in a certain restaurant.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 28, 1894

THE ELECTRICAL STOCK MARKET, to judge from the flood of gossip relative to this class of securities, has apparently awakened to new life. Not that any decided movements in quotations can be expected at this time, but it is an encouraging sign when Wall street, in periods of depression, such as now exist, even condescends to pay attention to the doings of the corporations represented by the issues listed on the exchanges.

GENERAL ELECTRIC at times has di splayed quite a deal of life at various times during the week, and, while no decided change is noted in its quotation, none the less the price is held with a firmness that is very gratifying to the friends of the company. There is a disposition to believe that the future of the company now holds out some promise to stockholders, and that measures will soon be taken that will pave the way to a resumption of dividends. As regards the financial outlook and plans ot the company, it may be well to quote some extracts from an interview with an officer of the General Electric Company, published in Wall street this week. This official stated that the company was now doing a business amounting to 70 per cent. of the volume of last year. Including supplies the company, is probably doing at the present time a gross business of $12,000,000 per annum. Something less than 3,000 men are employed full time at Schenectady, and about 1,400 men at Lynn. The company has no floating debt, nor are there any notes outstanding. The Fort Wayne Company, according to this authority, owes the General Electric nearly $1,000,000. Speaking of the impairment of capital, this official is quoted as saying: "The question of correcting the impairment in assets has not been considered recently, and will not come up until late in the fall. It will then be taken in hand and pushed to a speedy conclusion. In the meantime it will not be given official consideration. In the past a dozen plans have been suggested. It is safe to say that no dividend will be paid on the preferred stock until this matter is adjusted." Continuing, he said: "Prices of supplies of all kinds are, of course, much lower than they were a year ago. Electric cars with motor equipment are selling from $500 up. There has been a corresponding decrease in the prices of arc and incandescent light lamps. We do not regard the new Westinghouse incandescent lamp as a market success." From these remarks it may be noted that the officials of the company are very well pleased with its prospects financial and commercial, and the strength of the stock shows that Wall street is apparently disposed to put some faith in the statements that the affairs of General Electric are progressing favorably.

FORT WAYNE ELECTRIC stockholders have been treated to some revelations regarding the events leading to the receivership. through the medium of a circular sent out by E. S. Converse, R. L. Day & Co., Charles Head & Co., of Boston; B. F. Spinney, A. B. Martin, J. N. Smith, of Lynn; J. H. Bass, of Fort Wayne, and M. M. Belding, of New York, representing the minority stockholders. (The General Electric Company holds or controls a majority.) The minority stockholders are called on to deposit their certificates for mutual protection under an agreement that provides for a voting trust for a period not exceeding two years. The most interesting part of the circular has to do with a recital of the woes attending Fort Wayne under General Electric's patronage. The statement outining the events leading to the receivership is too lengthy to permit of any but brief extracts. In substance it says that General Electric holds about 42 per cent. of the capital stock, and individuals close to it hold enough more to give a small majority. In August, 1893, the General Electric refused to honor drafts for $130,000 made on it by Fort Wayne in the ordinary course of business, and refused any further financial aid. President R. T. MacDonald, of the Fort Wayne Company, which then had $1,500,000 discount obligations, personally relieved it by endorsements, etc., to the extent of $600,000. The General Electric then claimed to be a creditor of the Fort Wayne Electric Company for $1,000,000. This claim was disputed. The GeneralElectric then announced its determination to elect its own Board of Directors and take possession of the Fort Wayne property at the annual meeting on June 9. "The Fort Wayne Company, on June 4, 1894, owed $500,000 direct debt and $1,000,000 indirect, the latter discounted endorsements. The Fort Wayne Company has a valuable franchise and business and valuable assets; also a contract with the Thomson-Houston Company for a right to use the factory and machinery at Fort Wayne for some 10 years more. It seemed evident that the General Electric would undertake to pay the alleged indebtedness to itself and take to itself the business and good will of the company regardless of individual stockholders' interests. It had already tried to restrict the company's business. Therefore the application for receivers three days before the annual election." The receivers were authorized to continue the business and to realize the full value of its assets. The new Fort Wayne Electric Corporation was formed, and it contracted with the receivers "to furnish all labor and material for manufacturing and completing apparatus on hand and to carry on the business at the works in Fort Wayne, paying the receivers 20 per cent. on the cost of manufacture, and also a compensation of $2,000 per month." The effort of the General Electric to hold a meeting and elect its own officers has been so far defeated, the courts having postponed the meeting from month to month.

WESTINGHOUSE ELECTRIC preferred and common stocks continue strong on reports that the business of the company continues at the same big rate that resulted in the accumulation of such big profits in the last fiscal year of the property. From Pittsburg comes word that orders for the present month will probably exceed the orders for any month in the history of the company. This record-breaking business is now becoming a regulation thing with the Westinghouse Company. Every available inch of room is being made use of in the present shops at Pittsburg. The new works at Brinton are expected to be ready for occupancy in September. June shipments exceeded $500,000, and July orders thus far are in excess of this large amount.

BELL TELEPHONE quotations hold steady. The company has made no move yet looking to an early sale of any of the new capital stock. The net instrument output for July was but 676, a decrease of 1,623. The gross output since December 20, 1893, was 47,455 instruments, and the net output 7,006, a decrease of 19,708, compared with the same period in the year previous. This is good evidence as to the extent of the business depression.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, has declared a quarterly dividend of 1½ per cent., payable August 1.

THE SOUTHWESTERN TELEGRAPH AND TELEPHONE COMPANY has increased its capital stock from $2,000,000 to $3,000,000.

THE NEW ENGLAND TELEPHONE COMPANY has declared a dividend of $1 per share, payable August 15. This is an increase of 25 cents per share over the previous August dividends.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	96	98
* " " " Brooklyn	100	101	103
" " " Boston	100	117	120
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	15	17½
" " " " pref.	15	15	17½
Fort Wayne Electrict	100	1	2
General Electric	100	35¾	36½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref	50	50½	51½

BONDS.

	Par.	Bid.	Asked.
Edison Electric Ill., New York	1,000	106½	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	197	198
American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
Gold & Stock Telegraph	100	100	102
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	84⅛	84½

* Ex. div.

NEW INCORPORATIONS.

THE OELWEIN TELEPHONE COMPANY, Oelwein, Ia., capital stock, $5,000, has been incorporated.

THE CINCINNATI ELECTRIC SERVICE COMPANY, Cincinnati, O., capital stock $10,000, has been formed.

THE SANDUSKY TELEPHONE COMPANY, Sandusky, O., capital stock $50,000, has been incorporated.

THE STEUBENVILLE TRACTION COMPANY, Steubenville, O., capital stock $100,000, has been incorporated.

THE CLAMOND TELEPHONE COMPANY, Philadelphia, Pa., capital stock $300,000, has been incorporated.

THE INTERSTATE TELEPHONE COMPANY, St. Johnsville, N. Y., capital stock $3,500, has been incorporated.

THE LITTLE ROCK TELEPHONE COMPANY, Little Rock, Ark., capital stock $25,000, has been incorporated.

THE SEATTLE HOME TELEPHONE COMPANY, Seattle, Wash., capital stock $100,000, has been incorporated.

THE TOLEDO CONSOLIDATED ELECTRIC COMPANY, Toledo, O., capital stock $100,000, has been incorporated to supply light and power.

THE NEW ATHENS ELECTRIC LIGHT AND POWER COMPANY, New Athens, Ill., capital stock $4,500, has been incorporated by Paul Lehman and others.

O'FALLON, ILL.—The O'Fallon Electric Light, Power, Heat and Water Company has been incorporated with a capital stock of $20,000. S. C. Smiley, E. Tiedman.

THE CLEVELAND STORAGE BATTERY COMPANY, Cleveland, O., capital stock $150,000, has been formed to manufacture electrical devices, storage batteries, etc.

THE NORWOOD CONSTRUCTION AND ELECTRIC COMPANY, Chicago, Ill., capital stock $20,000, has been incorporated by E. D. Smith, N. Sampson and J. A. Low.

THE UNIVERSAL ELECTRIC MESSENGER CALL COMPANY, Portland, Me., capital stock $100,000, has been formed to manufacture electrical and mechanical appliances.

THE MONTGOMERY ELECTRIC LIGHT AND POWER COMPANY, Montgomery, Ill., capital stock $10,000, has been incorporated by L. Herd, J. G. Habermeyer and W. C. Weise.

THE ELIZABETHTOWN ELECTRIC LIGHT COMPANY, Elizabethtown, Pa., capital stock $10,000, has been incorporated by J. G. Stauffer, D. Z. Whitmer, J. C. Redsecker, S. S. Nissley and M. G. Kelly.

THE LOS ANGELES EDISON ELECTRIC COMPANY, San Francisco, capital stock $500,000, has been incorporated by Thomas Addison, of Berkeley, and S. E. Kearney, J. E. Green, J. R. Morton and F. M. Pickering, of San Francisco.

THE PITTSBURG, FRONTENAC AND SUBURBAN ELECTRIC RAILWAY COMPANY, Pittsburg, Kan., capital stock $75,000, has been formed to maintain and operate railways for the purpose of carrying passengers and freight by electricity, steam or other mechanical power, and to erect and operate an electric plant for supplying light, power and heat, etc. R. Simons, West Chester, Pa.; Sam. Barratt, R. Robyn, A. L. Chaplin, all of Pittsburg, Kan., and L. M. Bedell, E. W. Minturn and C. J. Simons, of Chetopa, Kan., are interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 30, 1894.

THE PECKHAM MOTOR AND TRUCK COMPANY, Kingston, N. Y., recently shipped a new type 29½-foot truck to a Chicago street railway. Among its features is the Meley roller-bearing box for the axles.

DR. ALLAN HORNSBY, secretary of the National School of Electricity, Chicago, is spending some time in New York, and during a call at the office of The Electrical World, reported that the affairs of the National School are in flourishing condition, and that many new classes are being founded throughout the country.

RAPID TRANSIT PLANS.—Messrs. J. W. Reno, R. W. G. Welling and Edmund Kelly have written a letter to the Rapid Transit Commission, giving a number of objections against the proposed wide tunnel plans and state that all of these are obviated in the double-deck plan, which has besides a number of other advantages.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 28, 1894.

THE PULLMAN COMPANY, it is reported, has entered into negotiations for the purchase of the General Electric plant at Lynn.

THE PETTINGELL-ANDREWS COMPANY have been apointed general selling agents for the well known Billings & Spencer commutator bars for the United States and Canada.

THE FRANK & KILBY ELECTRIC COMPANY, a new corporation, and located at 185 Franklin street, Boston, will hereafter manufacture and sell the Jupiter storage battery, as well as Moberg's dental and jewelers' drill, dealing also in primary batteries, portable electric lights, etc.

THE COLUMBIA ELECTRIC COMPANY, of Worcester, Mass., in the face of all competitors, has just been awarded the contract for the electrical work at the Westboro (Mass.) Insane Hospital. This is an old building and will require between 800 and 1,000 lights, dynamos and wiring.

AT A SPECIAL MEETING held in the town of Wakefield, Mass., on the evening of the 23d inst., it was voted to issue bonds for the payment of the Citizens' Gas and Electric plant for the sum of $180,000. The present plant cost the town $144,000 and the $36,000 additional is for enlarging the plant and making necessary improvements.

THE BOSTON RAPID TRANSIT BILL, having been submitted to its citizens on the 24th inst. for approval or disapproval, it was approved, but by a very narrow margin. It was certainly a very feeble expression of public opinion, the total vote being very small indeed. The bill is distinctly two separate measures, one allowing the Meigs elevated road to be built, and the other placing in the hands of the Subway Commissioners the power to build subways.

THE FIFIELD TOOL COMPANY has just been organized at Lowell, Mass., for the purpose of conducting the manufacture of lathes, succeeding the long established individual enterprise of Hon. George W. Fifield. A large three-story building has just been completed for the conduct of the business of the company. The reputation of the lathe manufactures of Mr. Fifield is well known to the electrical trade and so is he personally, having been one of the principal organizers of the Lowell Electric Light Company, of which he was first president, and which position he still retains. Mr. Fifield is one of Lowell's most prominent citizens and business men. He has been mayor of the city and is also president of the Appleton National Bank of Lowell.

THE ELECTRIC HEAT ALARM COMPANY, of Boston, is now comfortably located in its new office and factory at 145 High street, that city. The office is large and roomy, one side of which is converted into an exhibit board for its various systems, while its factory space is more than doubled. A neat sign, in raised letters, painted red, in harmony with fire alarm apparatus, ornaments the front of the building, thus rendering very conspicuous the location of the company. Business is steadily improving with the company, and General Manager Palmer is correspondingly happy. The company has just finished a large plant at Basin Mills, near Bangor, Me., and is at present installing a nice plant for the E. J. W. Morse Company at Roxbury. It has also placed bids on large plants at Lowell, Haverhill and Bangor. The following is an extract from a recent letter from its St. Paul agent: "After a most severe test, our journal-bearing alarms have been accepted by the insurance inspector, and he will advise allowance of 25 per cent. off the insurance rates." Its installation at the Pullman works is, of course, at a standstill because of the labor troubles.

THE CARNEGIE STEEL COMPANY, Limited, has just closed a contract with the Washburn & Moen Manufacturing Co., of Worcester, Mass., for what is conceded to be the largest electrical conductor ever manufactured. The dimensions of the same are as follows: Diameter of copper conductor, 1 15-16"; outside diameter (including the insulation), 2½"; area, 2,790,000 circular mils; length, 1,610 feet. This cable is to be installed in the new building now being erected by the Carnegie Steel Company, Limited, in Pittsburgh, Pa., which will probably be one of the most substantial, and with the most modern equipment in every feature of any in this country. The electrical installation will show the latest and most improved development of each particular type of electrical engineering up to date. Before placing its contract for the cable, the Carnegie Steel Company, Limited, solicited propositions and samples for testing purposes from all of the prominent wire manufacturers in this country, and it is certainly very complimentary to the Washburn & Moen Manufacturing Co. to learn that the sample submitted by them showed a conductivity of the copper of over 100 per cent., and the insulation resistance stood the highest test of all samples submitted. In addition to the above cable, or main conductor, the outfit calls for 50,000 feet of rubber-covered wires for distributing the current from the cable throughout the entire building. These wires, as well as the cable, are known as the "Crown brand" insulation.

PITTSBURGH NOTES.

PITTSBURGH, July 28, 1894.

THE STORY which has been going the rounds of the press of the country and also appeared in some of the electrical papers, stating that the opening of the electric works of the Westinghouse Electric and Manufacturing Company would be made the occasion for a grand formal dedication, in which Thomas B. Reed and President Cleveland were to take a prominent part, is officially denied in this city by the Westinghouse Company.

THE PITTSBURG, NEVILLE ISLAND & CORAOPOLIS ELECTRIC RAILWAY COMPANY has been sending out invitations for the last two weeks to the formal opening of the road, which came off in the most successful manner last Thursday. This road is in some respects a unique enterprise, inasmuch as the money to build it was raised and subscribed by and among the people who will use it. The capital stock is $250,000. The road has every prospect of proving a profitable investment. It will be used for passengers and also to carry freight and express packages. The freight cars will mainly be wanted to transport vegetables and garden truck from Neville Island to the markets of Pittsburgh and Allegheny. The road is six miles long and runs from Neville Island, in the Ohio River, across a bridge to Coraopolis and then to Temperanceville, where it connects with the West End line, which runs into the city of Pittsburgh. The formal opening was made the occasion for a grand celebration, in which nearly all the people who will be interested in the road took a part. One of the features was an al fresco lunch on Neville Island, with musical accompaniment and speechmaking.

News of the Week.

TELEGRAPH AND TELEPHONE.

ATLANTA, GA.—The Southern Bell Telephone Company has commenced the construction of a telephone line to Macon, Ga.

BEL AIR, MD.—Address Henry Haynes, secretary and manager of the Bel Air Telephone Company concerning a telephone system about to be established. The company is in the market for the necessary equipment.

PHILADELPHIA, PA.—The Mutual Automatic Telephone Company, 651 Bullitt Building, has obtained authority from the Councils, approved by the Mayor, to occupy all the streets of the city by its conduits and the right to use terminal poles in each block. It is the intention of this company, of which Col. W. H. Eckert is president, to cover Pennsylvania and adjoining States with its automatic system as soon as possible.

ELECTRIC LIGHT AND POWER.

KINCARDINE.—The citizens have raised $10,000 toward establishing an electric light plant.

SCOTLAND NECK, N. C.—Address S. F. Dunn regarding an electric light plant about to be established.

NORWOOD, PA.—G. C. Skelton may be addressed concerning the electric lighting contract about to be let.

HAZELTON, PA.—Morris Heckman, contractor, has the contract to erect an addition to the electric light plant.

ELBERTON, GA.—Address the mayor regarding a contemplated system of electric light plant and water works.

BALLARD CITY, WASH.—An ordinance is before the council to issue $50,000 in bonds for electric lights and other purposes.

RICHMOND, VA.—Address the city clerk concerning $100,000 to be appropriated for the erection of an electric light plant.

SYRACUSE, NEB.—A special meeting will be held to vote on the issue of $10,000 in bonds for water works and electric lights.

FORT DODGE, IA.—By popular vote an exclusive franchise for 25 years was voted to S. T. Meservey for electric lighting and street railway.

WINCHESTER, TENN.—Bracey Brothers and the McNair Company, of Chicago, have been awarded a contract to erect an electric light plant.

CHERRY CREEK, N. Y.—It looks as if Cherry Creek would soon have electric lights, as there is a strong probability of a plant being put in there.

ALLEGHENY, PA.—The Allegheny Common Council has authorized the city engineer to advertise for bids for machinery for the electric light plant.

TRENTON, N. J.—A. J. Wildman, of Morrisville, is said to be interested in the formation of an electric light company to supply the borough with electric light and power.

COUNCIL BLUFFS, IOWA.—Engineer Entyre has been instructed to prepare a map showing the position of the electric lights, with a view to receiving bids for cheaper electric lighting.

AUBURN, N. Y.—A number of merchants in the block bounded by Genesee, State, Dill, Water and North streets, are canvassing the feasiblity and advisability of starting a co-operative electric light plant.

COUNCIL BLUFFS, IOWA.—An appropriation of $1,000 has been made to enlarge the electric light apparatus at the State school for the deaf. A. T. Flickinger, 201 Shugart Building, may be addressed.

RIVERSIDE, CAL.—The city trustees have the matter under consideration of establishing a municipal lighting plant. Investigations show that the plant can be put in for $20,000, including engines, wires and everything complete.

BUFFALO, N. Y.—At meeting of Board of Aldermen the proposition to advertise for proposals to furnish an electric light plant at the Tower Pumping Station at a cost of not to exceed $45,000, was referred to the Commitee on Lamps.

ALEXANDRIA, VA.—The Potomac Electric Company's entire plant and property are advertised for sale August 25, by Geo. A. Mushbach, S. G. Brent,

John Critcher and Jas. K. Caton, commissioners of sales, appointed by the Circuit Court, by decrees entered in the chancery cause of J. C. O'Gorman against the Potomac Electric Company.

KANSAS CITY, MO.—The Lower House Committee has been for some time considering the conduit ordinance. Each ordinance was taken up and its different merits discussed. The committee is unanimous in its opinion that all wires should go underground as soon as possible. Probably at the next meeting of the council a report will be presented which will do considerable to settle the overhead wire nuisance.

JACKSONVILLE, ILL.— A resolution was adopted that the committee be instructed to prepare specifications and secure bids for an electric light plant, as suggested and described in the following report: The estimated cost would be for steam plant, $7,000; electrical plant, $23,000; total, $30,000. Cost of adding one boiler, $1,750; cost of adding one 80-light dynamo, with lamps and circuit, $10,000. A. Wood, W. W. Mitchell and Robert Hogarty are the committee.

MARSHALL, MINN. Sealed proposals will be received until July 31 by the Common Council for the construction of a combined water and light plant in and for said village. The plant will include the following items: One brick power house and stack, one steam power plant, comprising boiler, engine and pumps, set complete for use; one electric lighting plant. Proposals will be received for the water and lighting plant separately. E. T. Matthews is Recorder.

KANAWHA FALLS, W. VA.—The Great Kanawha Falls Water Power Electrical Manufacturing and Land Company has been organized to establish a plant to utilize the natural power produced by the water fall at that place. The power is to be used in generating electrical power and transmitting the same to Charleston and other points. The capital is $2,000,000. The office is at Charleston, and the incorporators are Chas. M. Reed, of Baltimore, Alex. McClintock, of Philadelphia, and others.

ROME, N. Y.—Sealed proposals for lighting the streets of the City of Rome with electric lights will be received until August 6. Proposals must be for one, three and six years, for 1,500 arc lights, more or less, of 2,000 c. p., to be lighted every night from sunset to sunrise. Also for the same lighted from one-half hour after sunset till one-half hour before sunrise. A preliminary bond of $2,000 must accompany each proposal. For further particulars address Ald. Chas. A. Fowler, chairman of Lamp Committee, or K. S. Putnam, Chamberlain.

WASHINGTON, D. C.—The War Department has made its report to the Senate concerning the feasibility of using the water power of the Great Falls of the Potomac for the purpose of lighting by electricity public buildings and gronnds of the District. The conclusion of the report is that electrical power can readily be transmitted from Great Falls to Washington, and that there are available, at the lowest stages of the river, 6,395 h. p. without storage of water, and 8,648 h. p. with storage, while only 4,408 h. p. are required for present lighting purpose. The total expense for 6,589 lights is given at $203,300; for one light, $52.33.

YOUNGSTOWN, O.—Sealed proposals will be received by the Board of City Commissoners until August 11 for the following lighting propositions: Proposition No. 1.—For the lighting of all the territory in the city of Youngstown, now lighted by the Sun Vapor Lighting Company, for a period of not less than one or more than ten years beginning February 1, 1895. Proposition No. 2.—For the lighting of the entire city of Youngstown for a period of not less than one or more than ten years beginning December 1, 1894. Under this proposition bidders will state the price at which they will furnish 300 or more 2,000 nominal candle power electric arc lights. Bidders will state the annual price per lamp. H. W. Calvin is clerk.

The Electric Railway.

MIDDLETOWN, N. Y.—An electric road will be built through Benton avenue.

LEWISBURG, PA.—A new electric road will be built between Lewisburg and New Berlin.

WOODMONT, CONN.—The construction of an electric road connecting Savin Rock to Woodmont is in contemplation.

WATERLOO, N. Y.—Work was commenced setting the poles on Exchange street for the extension of the electric railway on that route.

SANDERSVILLE, GA.—The building of an electric railway from Sandersville to Tennville is under consideration. J. N. Gilmore can give information.

SYRACUSE, N. Y.—The Syracuse Street Railway Company has secured a site for the erection of its power house. The building is to be of brick 120x150.

DUBOIS, PA.—The electric haulage power house at Brock mines was destroyed by fire. The power house, motors and engines were destroyed. Loss, $7,000.

POTTSVILLE, PA.—The new line which the Schuylkill Electric Railway Company will construct if Council gives its consent will ramify the thickly populated portions of said city.

TAMPA, FLA.—The Tampa & Palmetto Beach Railway Co. has been incorporated. The purpose is to cconstruct, build, equip, own and operate a street railway in the city of Tampa, and the suburbs thereof.

BALTIMORE, MD.—Jefferson Walsh & Son will erect the new power house, 69x300 feet, on South Howard street, for the Baltimore & Ohio R. R. Co. The structure is to be of brick, stone and iron and is to cost $47,000.

NORRIDGEWOCK, ME. At a special town meeting to see if people favored the building of an electric railway from Skowhegan, a resolution was adopted in favor of its construction, leaving all matters of location and manner of construction to the selectmen.

DE PERE, WIS. The Electric Light and Power Company decided to put in a flume and water wheel for the exclusive use of their plant, instead of taking the power from the Columbian Mills as at present. The improvement will cost about $5,000. The contract has been let to Janos Shepard.

PLAINWELL, MICH.—J. Neeley, owner of mills at Gun Marsh, has made a proposition to the citizens of Plainwell and Otsego to furnish them with electric lights. He will establish his plant and transmit the power from his flouring mill, seven miles from Plainwell, where he can obtain a fall of water of 100 feet.

RUTLAND, VT.—Mayor Kingsley has made a report from the Special Committee on the application of the Rutland Street Railway Company for a permit to institute electric power. The report included a statement of what changes the company propose in the line of railway and the features of the proposed system.

MALDEN, MASS.—The directors of the Malden, Melrose & Stoneham Street Railway Company have petitioned the selectmen of Stoneham for the location of tracks and permission to use the trolley system from Farm Hill, through Main street, through the Woodland Road to the Medford line.

PHILADELPHIA, PA.—The Philadelphia, Cheltenham & Willow Grove Electric Railway Company has awarded the contract to build the line from Rising Sun to Jenkintown over the York turnpike, to Wm. Wharton, Jr. Work is to commence on the line August 1, and must be completed through the borough of Jenkinstown by November 1.

PHILADELPHIA, PA.—The contract for the new power house to be erected on the south side of Callowhill street, above Twenty-Sixth, for the Hestonville, Mantua and Fairmount Railway Company, has been awarded to Chas. McCaul, who submitted plans to the building inspectors, who approved them. The estimated cost of the building and machinery is $250,000.

SYRACUSE, N. Y.—A site for the power house of the Syracuse Electric Railway has been purchased of A. C. Belden. It is situated between Tracy street and the canal, in the Third ward. A brick building will soon be erected 120x 150 feet. Electricity, with which to operate all the company's lines, will be generated there. The plant will be capable of supplying power for 60 cars.

SUMMIT, N. J.—The Township Committee, Chas. Day presiding, met to determine whether the franchise to erect an electric light plant should be granted to Messrs. George V. Muchmore and Jonathan Bonnel, of Summit, and Gilmore and Rundle, of New York. The members of the company agreed to have a specific contract drawn up to be submitted to the committee for approval.

COHOES, N. Y.—$3,500 was added to that already subscribed for the proposed electric belt line street railroad in Cohoes. The necessary $5,000, which is 10 per cent. of the capital stock of the new company, which must be paid in before the road can be incorporated, was paid in in cash, and the selection of fifteen incorporators and nine directors was deferred one week. Already $27,760 has been subscribed toward the project.

NIAGARA FALLS, N. Y.—The Niagara Falls Whirlpool & Northern Railway, the new electric railway to be constructed on the streets of the city, reported that they were ready to begin work at once, but had fonnd that it was impracticable to build on Bellevue avenue from Whitepool street to Main street. They therefore asked the Council to change their francbise so that they could go down Chase avenne instead.

COLUMBUS, O.—A movement is on foot to build an electric road from Columbus to Cincinnati. Right of way was granted by the County Commissioners, over the old national road from Columbus to the Madison county line. The persons who secured the right of way are Probate Judge L. D. Hagerty, Columbus; Henry B. Moorehead and Dennis Dwyer, Cincinnati, and O. M. Brown, Dayton. Other counties will be asked for the privilege of building the line through the public highway.

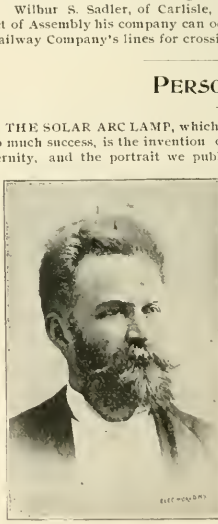
CHICAGO, ILL.—Sealed proposals will be received until August 2 for furnishing and delivering to the city of Chicago, at the city lamp shop, Rice and Lincoln Streets, Boulevard lamps as shall be ordered by the City Council, for which special assessments shall have been levied during the term ending June 1, 1895. Each lamp shall consist of a malleable iron frame, cast iron ornamental crown, opal glass shade, copper ventilation and glass globe. H. J. Jones is Commissioner of Public Works.

RED KEY, IND.—The much-talked of project to link Dunkirk and Red Key together with an electric railway has now developed the first step to reality. At a special meeting of the City Council at Red Key, Chas. B. McCulloch, of Boston, was given a franchise of the streets for the railway and the city contracted with him for street lights for a term of ten years, at $1,500 per annum. The same steps will be taken at Dunkirk, three and one-half miles distant. The power house for all will be located half way between the towns.

POTTSVILLE, PA.—Mr. S. B. Edwards, solicitor for the Pottsville, St. Clair & Minersville Electric Railway Company, said that the company will be ready to commence building its road immediately after the Borough Council shall have given it the right of way to occupy certain streets of the town. The road is to be ten miles in length and there is a capital of over $150,000 to back it. Wilbur S. Sadler, of Carlisle, is president. Mr. Edwards says that by an act of Assembly his company can occupy about 500 feet of the Schuylkill Electric Railway Company's lines for crossings and circuit connections.

Personal Notes.

THE SOLAR ARC LAMP, which has recently been placed on the market with so much success, is the invention of an electrician not unknown to the fraternity, and the portrait we publish herewith will be recognized by many workers in the electrical field as that of Mr. Gerg Kirkegaard. Mr. Kirkegaard was born in Copenhagen, Denmark, in 1863, where he received a fairly good education under a private tutor up to his fourteenth year, when he was apprenticed to learn the trade of a mechanical engineer. After his apprenticeship he attended the Technical Institute, from whence he was graduated with high honors. He worked for some time in the Royal Navy Yard in Copenhagen, and later with John Crane & Co., at Govan-on-the-Clyde, Scotland. He arrived in New York in 1886, and at once entered the employ of the Edison Company as a machinist in the shops, from which position he was rapidly advanced, first to draughtsman at the works, and later to become Mr. Edison's private draughtsman at his laboratory, where he remained two years, until 1889, when he visited his native country to attend the exhibition then being held there. Upon his return he was employed by the Excelsior Electric Company to take charge of its lamp department, and later acted in the same capacity with the Universal Arc Lamp Company. In 1891



he brought out his first invention in arc lighting, and has since taken out several patents on arc lamps. He is the patentee of the lamp manufactured by the General Incandescent Arc Light Company, which was one of the few arc lamps awarded a medal at the World's Fair. Mr. Kirkegaard is a member of the American Institute of Electrical Engineers, and is well and favorably known both in the fraternity and among his countrymen in the United States. It was he who conceived the idea of erecting a statue in Central Park, New York, of Bertel Thorwaldsen, the world-famous Danish sculptor, the cost to be defrayed by voluntary contributions from the Danish residents of New York and Brooklyn. His efforts have arrived at a successful fruition, and the memorial will be in position for dedication in November next. Mr. Kirkegaard is now superintendent of the Solar Arc Lamp Company, of 351 and 353 Jay street, Brooklyn, which was recently organized by him. With the qualifications of both a skilled mechanic and a man of unlimited energy, we predict for him a prosperous future in the business in which he is now interested.

MR. EDWARD CALDWELL has resigned the editorship of the *Street Railway Gazette*, and accepted a position on the editorial staff of the *Street Railway Journal*.

MR. HORATIO A. FOSTER has accepted the editorship of our esteemed monthly contemporary, *Electric Power*. Mr. Foster, who is also the American representative and assistant of Prof. Geo. Forbes, brings to the position a wide knowledge of electrical engineering gained in central station work and in connection with his duties as electrical census expert, and a direct acquaintance with editorial duties from his former editorial connection with Electrical Industries.

Miscellaneous Notes.

HIGH SPEED COMPOUND ENGINES.—In a recent test of three 440-h. p. compound Westinghouse engines made for the United States Government pumping plant at Sault Ste Marie, Mich., the expert, Mr. Julian Kennedy, reported that with 150 pounds boiler pressure and no vacuum, the steam consumption per i. h. p. was 22.39, 21.66 and 21.84 pounds per hour respectively, the consumption per brake h. p. being about 10 per cent. greater.

TESLA AND MOORE.—The following extract is from a newspaper syndicate article entitled "Light Without Lights." "It may be mentioned at this point that to D. McFarlan Moore, the American electrician, who has done as much to popularize the use of electric light as any living man probably, belongs the credit of having first called the attention of scientists to the impending change. Tesla has indeed been experimenting for years, and long ago indicated the lines along which the transformation would be wrought. Mr. Moore, however, demonstrated why the near future will witness the commercial adoption of the transmission of light through tubes, and that electricity is to be the agent of this consummation. * * Mr. Moore makes the assertion that electric sparks rapidly succeeding one another in a vacuum are the key to the whole treasure house. This fact is shown by means of an ingenious contrivance now familiar to most electricians, in which the current of electricity is repeatedly broken by rapid vibrations. The vibrations produce a corresponding number of sparks which act upon the ether in a bulb duly placed to be effected in precisely this manner, with the result that the whole bulb gives forth light. Such electricians as Nicola Tesla and McFarlan Moore would not put the condition of things into such simple words, Mr. Moore, indeed, saying, and very scientifically, no doubt, that the whole thing is the result of the current being rapidly disrupted by a magnetic field exterior to the evacuated space."

Trade and Industrial Notes.

THE GENERAL ELECTRIC COMPANY has closed a contract for the electrical equipment of the new road of the Jacksonville Railway Company, consisting of two 100 kw. generators and nine double-motor equipments.

THE WASHINGTON CARBON COMPANY, of Pittsburgh, Pa., is building a 75x190 foot extension to its present factory at Washington, Pa. The present quarters were found to be inadequate for the rapidly-growing demand for its carbons.

ROGER & ATWATER, 214 Pine street, San Francisco, have taken the agency for Pacific Coast for A. O. Schoomaker, 158 William street. They carry a full line of his India mica, cut, uncut and stamped for segments, and can consequently fill orders promptly.

THE HARRISON BOILER WORKS, Philadelphia, send us a well gotten up pamphlet on the Cochrane Separator, containing detail view of this well-known apparatus with directions for placing and connection, and other information useful to purchasers and steam users in general.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received the contract from M. E. Henry & Co., of New York, N. Y., to cover their stone yard with an iron roof, and also for a traveling crane. The building will be 50 feet in width and 10 feet in length, constructed entirely of iron, the whole space to be controlled by the traveling crane.

THE KEYSTONE ELECTRIC COMPANY, of Erie, Pa., has sold 34 elevator motors to the Smith-Hill Elevator Company, Quincy, Ill. The reports and testimonials received from users of the Keystone elevator motor are gratifying, so much so that the company has decided to devote almost its entire attention to the manufacture of these motors, and will make them its specialty hereafter.

THE SHOOK-ANDERSON MANUFACTURING COMPANY, of Pittsburgh, Pa., has been awarded the contract for furnishing and installing the engines, boilers, heaters, pumps and piping for the Norfolk Street Railway Company, Norfolk, Va. This contract amounts to $40,000. The same company has also just completed a contract with the Indianapolis Street Railway Company for piping, pumps, heaters, etc. It has also just installed in its shops a new Babcock & Wilcox double boiler of 350 h. p.

THE ELECTRIC APPLIANCE COMPANY, Chicago, anticipating to some extent the present condition of the market in this respect, to porcelain tubes, arranged some time ago to carry a very large stock of these goods, and is now in shape to meet all demands. It has just issued a complete catalogue of electrical porcelain goods and is distributing the same among the trade, and will be pleased to send them to any who have not been supplied.

JAS. I. AYER & CO., St. Louis, Mo., as engineers for J. L. Hudson, St. Louis, have closed a contract for one 15 kw. and one 25 kw. M. P. 110-volt generator, to be direct connected to Russell engines, the plant to be installed in J. L. Hudson's clothing house. The same firm are also engineers for the plumbing and steam fitting, the contract for the boilers and other apparatus not having yet been let.

GEO. L. COLGATE, 136 Liberty street, New York, is sending out catalogues and circulars of some of the standard articles for which he is exclusive selling agent in this territory, or for the entire United States. Among these are the McNutt incandescent lamp, made at Warren, O., the swinging ball lightning arrester, Star wire mouldings and the excellent Whitney voltmeters, ammeters and indicators.

THE SEBASTIAN LATHE COMPANY, Cincinnati, O., in a 48-page pamphlet gives descriptions with prices of the numerous forms of engine and speed lathes and other machinery manufactured by it. The descriptions are full and the engravings of good size and well executed. Besides numerous lathes there are illustrated and described various other tools, such as drill presses, shapers, etc., castings for engines from one to six horse power, and machinists' supplies.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has issued a neat pamphlet on the stopper incandescent lamp, which, commencing with a short account of incandescent lamp litigation and the lighting of the World's Fair, gives illustrations and particulars concerning the stopper lamp. In the section on "Tests" it is stated that instead of the candle power decreasing with age, with the stopper lamp after 600 hours there is absolutely no fall in candle power whatever and no material increase in average watts per candle required

MESSRS. F. E. BAILEY & CO., Betz Building, Philadelphia, report the following recent sales of Eureka Oil Purifiers: W. R. Fleming & Co., New York and Boston; Bausch & Lomb Optical Co., Rochester, N. Y.; the Portland Hotel, Washington, D. C.; The Newtown Electric Light & Power Company, Newtown, Pa.; The Oneida Electric Light & Power Company, Oneida, N. Y.; the Cerealine Manufacturing Company (two barrel), Indanapolis, Ind.; Messrs. C. R. Rumpp & Son's new building, Philadelphia, Pa.; the Bavaria Brewery, Wilmington, Del.; Germania Park & Steamboat Company, Philadelphia, Pa.; Sauquoit Silk Manufacturing Company, Scranton, Pa. Orders for a number of machines have also been received for Cuba and elsewhere.

THE GARLOCK PACKING COMPANY.—In 1883, Mr. O. J. Garlock, whose occupation at that time was chief engineer for the firm of Bartle & Eames, invented a packing, and after many successful experiments applied for and was granted letters patent for the United States and Canada. Being a practical engineer he fully understood what was wanted in the way of a packing for steam, water and ammonia. The business was commenced in a small way without capital, and the continued increase made it necessary to secure facilities for properly conducting it. The members of the firm at present are: O. J. Garlock, E. Nichols and F. W. Griffith, as organized in 1887. Since that time the business has developed with phenomenal rapidity, and the Garlock Company now manufactures its packings in Palmyra, N. Y., and Rome, Ga., and also has extensive offices and warerooms in New York at 136 Liberty street, Philadelphia, Pittsburgh, St. Louis, Omaha and Chicago. It may be interesting to our readers to know that its business, notwithstanding the hard times, was nearly doubled in 1893 over the previous year.

THE ELWELL-PARKER ELECTRIC COMPANY OF AMERICA, Cleveland, O., the representatives in this country of the widely known Electric Construction Company, limited, of London and Wolverhampton, England, has issued a large page catalogue illustrating various forms of Elwell-Parker apparatus. The Liverpool Overhead Railway is one of the many important engineering works carried out by the home company, the list of which contains a large number of central station, street railway, copper depositing and other electrical plants. The specialties of this company are direct current dynamos, 10 to 1,000 horse power for traction plants, power transmission, lighting and copper depositing direct current motors, 5 to 500 horse power, for traction, power transmission and driving shafting, cranes, etc., in mills, factories, etc.; alternating current generators, 50 to 500 horse power, for lighting plants; ampere meters, 10 to 2,000 amperes, for direct or alternating currents; voltmeters, 25 to 600 volts, for direct or alternating currents. Illustrations are given of various sizes of dynamos, a street railway truck, the generating station of the Liverpool Overhead Railway, etc.

FISHER & PORTER, 1025 Monadnock Block, report that they have just installed two 80-h. p. M. A. Green engines in the Leland Hotel, where they are running two National dynamos for incandescent lighting. They have sold one 150-h. p. "M. A. Green engine" to the Freeport Electric Company, of Freeport, Ill., for electric street railway work, and one 300-h. p. "improved Greene" engine to the Hammond, Whiting & East Chicago Electric Railroad Company, at East Chicago, Ind. Messrs. Fisher and Porter are Western representatives of the Altoona Manufacturing Company, building the "M. A. Green" engine, and of the Providence Steam Engine Company, building the "Improved Green" engine, and report that the works of both companies are running full time, and that they see prospects ahead for a good business. They have received a letter from the Farmington Electric Company, of Farmington, Ill., where they installed last Fall the first "M. A. Green" engine which had then been placed west of Pittsburgh, stating that "the M. A. Green engine is a dandy, keeps right along doing its work without a jar or stop, giving us a steady, uniform light. We consider that our plant, purchased through and put in by Albert Fisher last Winter, is one of the best in the West outside of the large cities. We are satisfied that we could not have done better."

Business Notices.

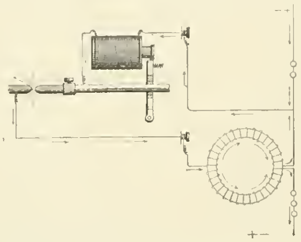
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 24, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

523,354. ELECTRICALLY PROPELLED PERAMBULATOR; Emil E. Keller, Chicago, Ill. Application filed April 20, 1892. In a perambulator, the combination of a frame and wheels, with an axle, a worm wheel on such axle, a case for such worm wheel, and a support for such case, consisting of two parts on the axle, a large aperture collar about the same, two disc-shaped plates at the ends thereof, and anti-friction rollers between the disc-shaped plates and the parts on the axle.

523,369. ELECTRICAL IGNITING DEVICE FOR GAS ENGINES; Alonzo J. Painter, Pasadena, Cal. Application filed July 8, 1893. The combination with the ignition chamber of a gas engine having opening in the wall thereof, of a bushing of insulating material in one of the openings, a metallic sleeve in the bushing, a contact carried by the shaft, an arm carried by one of the shafts, an arm secured to the casing of the ignition chamber, and a spring connecting the arms.



No. 523,401—Method of Working Arc Lamps.

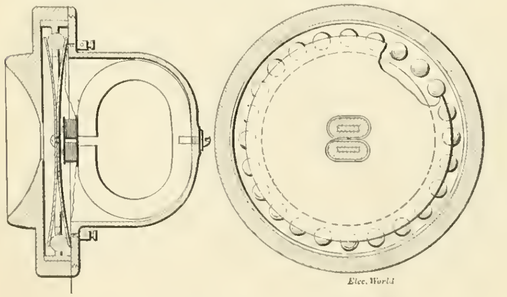
523,371. SECONDARY BATTERY; Antoine Peyrusson, Limoges, France. Application filed November 1, 1893. In an accumulator, a positive electrode, the same consisting of metallic laminæ, soldered to a central metallic core, end discs of lead retaining said laminæ, capping discs of insulating material covering and projecting beyond the lead discs so as to prevent all contact thereof with the negative electrode.

523,395. MULTIPLE FILAMENT LAMP; Albert L. Clough, Manchester, N. H. Application filed August 2, 1893. The combination with a multiple filament incandescent electric lamp provided with separate terminals of a switch provided with line terminals, an independent terminal and movable members co-operating with said terminals.

523,396. ELECTRIC RAILWAY SYSTEM; Albert C. Crehore, Ithaca, N. Y. Application filed July 20, 1894. In an electric railway system, the combination with the series of working conductors of a contact or contacts adapted to move from one section to another without break of circuit, a series of magnetic switches for connecting the sections to a line, an auxiliary conductor over which the electromagnetic switches may be operated, and a storage battery in a branch of the power circuit on the car around the auxiliary conductor branch.

523,401. METHOD OF WORKING ARC LAMPS. William S. Horry, New York, N. Y. Application filed October 17, 1893. The method of suiting an alternating current to arc lamps which consist in causing said current to generate a secondary current by means of a transformer, and permitting said currents to magnetize the core of the transformer to saturation, whereby the current through the lamp decreases as the voltage or resistance between the lamp carbons increases. (See illustration.)

523,444. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; Charles H. Richardson, Philadelphia, Pa. Application filed April 26, 1894. The combination, in controlling mechanism for electric motors, of the carrier, composed of the box or casing having the end or front opening, the resistance, the contacts thereof, reversing contacts, armature short-circuiting contacts, and contact separator all contained within the carrier, and the switch actuating lever mounted within the carrier and provided with the arm projecting therefrom by the end opening, and adapted to be actuated by the foot.



No. 523,630—Telephone.

523,453. MODE OF MOUNTING DYNAMOS ON CAR TRUCKS; William Biddle, Brooklyn, N.Y. Application filed October 6, 1893. The combination with the car axle and a dynamo of the equalizing bars, a transverse platform connected to and supported by the equalizing bars and carrying the dynamo, a pinion upon the shaft of the dynamo, and an engaging wheel upon the car axle for operating the dynamo from the rotation of the car axle, and longitudinally inflexible connections from the car axle to one pole piece of the dynamo, whereby a constant relation is maintained between the car axle and dynamo, substantially as set forth. (See illustration.)

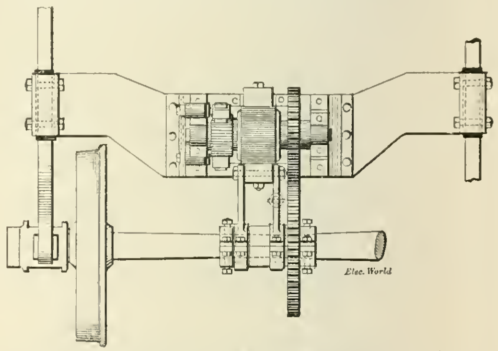
523,460. INCANDESCENT ELECTRIC LAMP; Francis M. F. Cazin, Hoboken, N. J. Application filed December 7, 1892. An electric incandescent lamp in which the semi-conductive matter intended and adapted to glow is closely, directly and hermetically embedded in non-conducting solid matter made up of two parts of different points of fusion.

523,461. ELECTRIC INCANDESCENT LAMP; Francis M. F. Cazin, Hoboken, N. J. Application filed July 24, 1893. An electric incandescent lamp, in which semi-conductive or carbonaceous matter is embedded in solid material, consisting mainly of two parts, one selected for high point of fusion and the other with regard to transparency and luminosity under the action of both light and heat, the part of the solid material intended to spread light being surrounded by an air space and by a cap or cover of highly transparent material.

523,471. ELECTRIC SNOW PLOW; Louis J. Hirt, Somerville, Mass. Application filed November 20, 1893. In an electrically propelled snow plow, a metallic truck frame, having sides composed of two channel bars and ends composed of channel bars, and gusset plates to which the said side and end bars are secured.

523,491. BLOCK SIGNAL SYSTEM; George L. Thomas, Brooklyn, N. Y. Application filed March 26, 1894. The signal system, comprising series of signals, signal operating circuits under the control of a train, the train acting to cut out portions of the circuits, a main battery for each of said circuits and an auxiliary battery and circuit for controlling the signals when the main battery is cut out, and means under the control of the train for temporarily cutting out the said auxiliary battery from affecting a certain signal before the cutting out of the main battery from affecting that signal.

523,566. ELECTRICITY COUNTER; Francois A. Brocq, Paris, France. Application filed September 21, 1893. In a counter for electricity, a vessel containing liquid, in combination with an electrically controlled float in said liquid, the movement of which float serves to record the intensity of the current to be measured, the float expanding with variations in temperature whereby its balance is maintained at all times.



No. 523,453—Mode of Mounting Dynamo on Car.

523,572. ELECTRICAL CONVERTER; Robert H. Hassler, Dayton, O. Application filed August 4, 1893. In an induction coil or converter, the combination of the primary and secondary coils, and a magnetic core consisting of iron plates extending around the exterior of said coils and assembled in groups forming closed magnetic circuits, the core being of approximately hexagonal section, and the coils having a major portion of their surface uninclosed by said magnetic circuits.

523,586. STARTING AND CONTROLLING DEVICE FOR ELECTRIC MOTORS; Joseph W. Moore, Boston, Mass. Application filed April 25, 1894. In a starting and controlling device for electric motors, the combination of an armature-circuit divided into two branches or lines, a variable resistance or rheostat included in one of the branches, a differentially wound solenoid, consisting of two helices, one of the helices being included in the other branch of the armature circuit and connected in parallel with the variable resistance and in series with the armature, and the other helix being included in another circuit and controlled by the first named helix and a contact arm connected to the core of the said solenoid and adapted to cut in and out the variable resistance, the movement of the contact arm being controlled by said solenoid.

523,613. TELEPHONE SWITCH; Jacob Oscar Aiegler, Boston, Mass. Application filed May 10, 1894. A telephone switch, consisting of fixed and movable members adapted to embrace and together sustain a receiver, said movable member being pivoted to swing about a vertical axis, into one or another position, and contact springs co-operating with said movable member, substantially as described.

523,617. SIGNAL TELEGRAPH; Claudius V. Boughton, Buffalo, N. Y. Application filed November 13, 1893. A signal telegraph, consisting essentially of a number of electric lamps arranged in a continuous line, a number of keys arranged upon a casing, each key being designated by a letter of the alphabet as a numeral, and electrically connected with the necessary lamps to form the dots and dashes called for by the letter or numeral of the key in operation, and a printing mechanism electrically connected therewith, which automatically and simultaneously records each letter or numeral displayed upon the staff of lamps.

523,630. TELEPHONE; Stephen D. Field, Stockbridge, Mass. Application filed April 7, 1894. In a telephone, the combination of a compound diaphragm, composed of a plurality of plates and anti-friction bearing surfaces separating and supporting the edges of said plates. (See illustration.)

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CONTENTS.

ELECTRIC ILLUMINATION.

The paper read by Prof. Anthony at the Philadelphia meeting of the American Institute of Electrical Engineers showed that comparisons between different sources of illumination should not be made on the basis of the candle power alone, and it was demonstrated that for efficient lighting a great deal of what we may call the watt economy of large units like arcs is lost. In the Digest will be found an abstract from a French author that extends the calculations of Prof. Anthony, and gives a simple graphical method for determining the height at which a source of illumination should be placed in order to obtain the most efficient lighting. It would seem that the reflector above alternating arcs might be so shaped as to obtain more nearly the distribution of light most desirable, and that with continuous current arcs a more efficient distribution might be attained by the use of an upper carbon different in size and quality from the lower one. The subject of illumination has not yet received the attention it deserves and probably will not until a standard of illumination has been adopted. Candle power is not the only factor that enters, and if this were more widely recognized we would not see so many arcs used in small towns and villages, where the incandescent lamp for street lighting would not only be more appropriate and efficient, but also in most cases less expensive for the same average illumination.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

We print elsewhere the preliminary programme of the fourth annual meeting of the American Electro-Therapeutic Association to be held in New York City the latter part of next month, which, it will be seen, is a most extensive one. Many of the names of those who will read papers are familiar to all electricians, for besides Drs. Goelet, Morton, Herdman, Apostoli and others whose reputations have extended beyond medical circles, we find Messrs. Kennelly, Houston, W. J. Jenks and Profs. J. W. Langley, J. O. Reed and A. E. Dolbear, representing the more purely electrical profession. That electricity occupies such a prominent place in the medical profession as implied by the programme of this society, of which there are several similar ones in this country, is somewhat surprising, and is another indication of the manifold nature of the new agent. One of the hoped for results from these bodies is a recasting of electro-medical nomenclature to bring it more into harmony with modern electrical language. The queer jargon found in some works on medical electricity may at one time have had its use, but now that we have an authoritative system of electrical names and notation, based upon logical and scientific principles, it would seem that medical nomenclature could be brought into closer accord with it. The different properties of electrical currents can be clearly expressed without resorting to names based upon their origin, and writing of faradic, voltaic, galvanic and franklinic currents as if they were distinct varieties of electricity.

PRECISION OF MEASUREMENTS.

It is often amusing to see the manner in which figures are carried out to a large number of decimal places, when the accuracy of the measurement of the quantities to which they refer is perhaps limited to the place of units. Many persons have an idea that greater accuracy results if a number is thus carried out to several places of decimals or if logarithms are used, and the writer once heard a man, who enjoys a national reputation as a mechanical expert, remark, when it was pointed out that certain measurements were probably not correct

within a unit, that he would use seven-place logarithms to calculate them with, and thus obtain very accurate results. A good rule to follow is not to carry out averages and other calculations more than one point beyond the limit of the accuracy of measurement, the extra figure being to take up fractions. To do otherwise merely adds figures that mean nothing and which are likely to give the impression that the writer is either seeking credit for an accuracy which is not deserved, or that he does not know that the limit of accuracy of measurements can not be extended by such additions. In computing the average readings of voltmeters and ammeters, for instance, we frequently find the figures carried out to the thousandths place when it is very doubtful if the unit place is right within a volt or ampere. There is no necessity for this show of accuracy, even if it is thought within the limits of probability, for in practically applying such numbers, all figures must be lopped off beyond the range of the scale to which they apply. In ordinary linear measurements, for example, one-hundredths of an inch is the usual limit, yet the expert above referred to on one occasion instructed a workman to lay off a dimension in which the decimal part of an inch was expressed to thirteen places, though the quantity had never been determined closer than the third place of decimals even in the physical laboratory. One of the reasons why practical men look askance at much technical writing is because their training makes such absurdities very apparent and therefore naturally creates a prejudice in their mind against the practical value of everything the author says.

POLYPHASED MOTORS.

We publish in this issue Dr. Bell's Institute paper on polyphased motors, which will repay careful reading, for it is probably the most practical contribution on the subject yet made. Two of the notable advantages of induction motors are strongly brought out—the absence of commutators and freedom from burn-outs—which imply that no skilled attendance whatever is required in their use. Another advantage is that such motors can be placed equally well in any position—upside down or on their side—and in any out-of-the-way place, as the only attendance required is attention to bearing oil cups. It is shown that such machines may stand an overload of from 30 to 60 per cent., and that if loaded beyond a point that might involve damage, the motor stops, when a fuse will cut off the current. The close regulation of induction motors is one of their good points, and Dr. Bell states that in ordinary good practice the speed variation, will not be greater than 5 or 6 per cent. from no load to full load, while they have been designed with no difficulty to reduce this variation to 2.2 per cent. or less. As to great speed variation it is stated that this can be accomplished through the same range, and with as much facility, as with the series continuous current motor controlled by a rheostat, and that the falling off in efficiency is no greater with the former than with the latter. Comparison also with continuous current shunt motors leads to the general conclusion that the polyphased motor is perfectly capable of a complete control of speed on the same terms generally obtained with continuous current motors. It would be interesting to know if this would be commercially the case with polyphased motors applied to mining purposes, where the speed must be subject to wide variations in pumping, hoisting, etc. About two years ago a contrary conclusion, after wide investigation, was arrived at, with the result that their use was not recommended in a case where otherwise several thousand horse power would have been employed. It should be added that in this particular case, continuous current motors were not considered sattsfactory on account of the care and low voltage required, and the necessity of their being installed in only favorable places, and that these properties of the polyphased motor led to the investigation which was made with a view to displacing the others, and to largely extending the electrical plant. Another point of interest in the paper is, that through the working range of a well designed induction motor the false current is very small, and is only about 30 per cent. at friction load. This shows that the claim of requiring larger generators on account of false currents and of the line being loaded up by them has little foundation in fact. Even if the false current was much larger than here shown at light loads, it would not require a larger size of line conductor, as sometimes claimed, for the full load current is always almost in phase with the E. M. F. and greater than the volt-ampere current at any other load.

COST OF PRODUCING ELECTRICAL ENERGY.

The paper read by Mr. B. J. Arnold at the recent convention of the North Western Electrical Association, and reprinted in The Electrical World of last week is a valuable contribution to a subject that has not received the attention in the past that its importance calls for. In the present issue we print the first portion of an article from an English correspondent which adds some further valuable data. The cost of electrical energy depends so largely upon the load factor that without assuming a value for this, any result quoted is likely to be very misleading. To increase this factor is now the greatest problem before central station managers, and the suggestion of Mr. Arnold to add an ice plant is an excellent one. It is also unquestionable that notable economy will result from the addition of a storage battery, both from a reduction in first cost of a plant and from the machinery being continuously operated at its point of maximum efficiency. To these should be added a saving in fuel from less waste by radiation, and less waste in furnaces from banked fires and admission of surplus air to light fires, and also in the cost of labor per ton of fuel burned. While in some cases a considerable distributed motor load may be added, in the great majority of stations thus far not much assistance has been obtained in this way, and it will be good policy for the station manager to attempt to open up other avenues of relief. In most of the data given for the cost of electrical energy, fixed charges are omitted, notwithstanding that it is one of the largest factors. In our issue of June 9 we showed that the investment per kilowatt in twelve dividend paying stations in Massachusetts averaged $573, and in many exceeded $600 per kw., though it is probable that this exceeds what similar plants could be laid down for to-day. We will assume that the above figures can be reduced to $500 per kilowatt, of which $400 represent that part of the plant subject to depreciation, which will be assumed at 5 per cent. per annum. The calculations upon which the following table is based rest almost entirely upon assumptions, but it may, however, serve as an illustration of the effect of various factors, and by filling in the actual figures for a given case, will perhaps furnish indications of some direct value. The different quantities in the first column are based to some extent upon the figures of Mr. Arnold and the reports of the English Board of Trade, and the other columns show how they are affected by the load factor. The capital charges are on a basis of 6 per cent., and the depreciation and current repairs are assumed somewhat higher for larger loads, and the cost of fuel lower.

TABLE SHOWING EFFECT OF LOAD FACTOR.

Load Factor	.2	.4	.6	.8
Capital Charges	1.70	.85	.57	.42
Depreciation	1.20	.66	.44	.33
Management and Taxes	1.50	.75	.50	.40
Current Repairs, etc.	1.00	.55	.40	.30
Fuel	1.50	1.40	1.30	1.20
Labor	1.50	1.20	1.00	.90
Petty Stores	.20	.15	.10	.08
Cost per kilowatt-hour, cents	8.60	5.56	4.31	3.63

As the total for a load factor of .2 is much below what is now attained in this country, the table does not represent present practice, but the different factors are believed to represent what may easily be realized.

Behind the Times.

In a recent meeting of the London Technical Education Board, Mr. Senior, a delegate representing the electrical trades, stated that the electrical industry was as yet in its infancy, and was in a very crushed condition.

Electric Lighting in Great Britain.

BY E. RAY STEVENS.

It is a recognized fact in Great Britain that America is much in advance of the United Kingdom in the perfection and in the use of electricity as a means of public lighting, and especially as a motive power. An inspection of the plants here shows that a surprisingly large number of them are fitted with American machinery, despite the fact that much machinery for this purpose is now being manufactured in England.

In the use of electricity as a motive power England has been very backward. All told there are not more than a dozen electrical street railway lines in the United Kingdom, and some of these are experiment lines only, as is the case with a short line recently built by the Thomson-Houston Company at Leeds. That city has just purchased the lines of the private company that had been operating them, and will replace the engines now used upon the lines with either cable or electricity. Liverpool has a very successful elevated railway operated by electricity. In Birmingham it is being used on a portion of the city tram lines. Blackpool has an underground conduit system, and besides these cities there are not to exceed a half dozen others where electricity is used as a motive power on the street railway lines.

One reason for this condition is found in the great opposition to its adoption on the part of the National Telephone Company, which was so completely in possession of the field that it was usually able to defeat all attempts to use electricity as a motive power, because of the fact that its use interfered with the workings of the telephone lines. But this opposition has now been made much less effective. There is a general feeling among tram managers that some other power should be adopted in place of the horses and the engines now largely employed. Electricity and cable are the favorites. Electrical traction will undoubtedly make great advances in Great Britain during the next decade.

The electric lighting industry, like that of supplying gas and local transportation, is regulated by an act of Parliament, and is placed under the immediate supervision of the Board of Trade, which has very wide powers in controlling the establishment and the operation of plants for supplying electric light. This law, passed in 1882, contained a clause giving cities the power to purchase their plants at the expiration of twenty-one years, as well as at the end of every period of seven years thereafter upon paying the present worth of the plant as fixed by arbitration. It was especially provided that this value should be fixed without "any addition in respect to compulsory purchase, or of good will, or of any profits which may or might have been or be made from the undertaking, or of any similar consideration."

The speed of electric lighting was undoubtedly hampered by the provisions of the act, as it was found difficult to secure capital upon favorable terms for the establishment and operation of the business, which was at that time considered in England a rather uncertain investment, even under favorable conditions. But the act was amended in 1888, extending the period at which the city had the option to purchase to forty-two years, and to every ten years thereafter. Since that time the extension of electric lighting has been more rapid, partly due, no doubt, to the amendment.

The Board of Trade has the power to grant provisional orders, which must be sanctioned by Parliament. Licenses, which are good for seven years, may also be given, but, as a matter of fact, this is rarely done now. The act grants the usual powers to the company, and at the same time reserves to the Board of Trade a large control over the affairs of the company, subject, of course, to general provisions as to the manner in which the plant is to be established and operated.

When a company applies for a provisional order, a formal notice of the action must be given to all those who are at that time engaged in supplying electricity in that district. The application must be accompanied by detailed information as to the kind of plant to be established and the district to be supplied. It must also show that the consent of the local authority has been gained, and the company must demonstrate to the satisfaction of the Board that it is able to carry out the proposed work, and if the order is granted it must make a deposit as security for the faithful execution of the plans proposed. Its system must be sanctioned by the Board, and, if overhead construction is to be used, the express sanction of the municipality must be obtained as well. There is, however, little opposition to the overhead system outside the larger cities.

The regulations provide, with considerable minuteness, the manner in which the lines shall be constructed and maintained. Especial care is taken in regard to the support and insulation of the wires, so as to prevent, if possible, all injury to the public. When once established the plant is obliged to supply all those who wish the service that are within its district. The Board fixes the methods that may be employed in charging for the service, and also the maximum price that may be collected for it.

The companies are required to prepare and have printed annual statements that will show the receipts and expenditures of their business. These they must keep for sale to all who care to buy them at a price not to exceed one shilling. In order to insure their correctness, auditors are appointed, who, each year, examine the books and accounts that have been prepared. The expense of this examination is in each case borne by the company. Provision is also made for the appointment of inspectors, whose business it is to periodically examine the plant of the company and to make special examination of meters or portions of the line when complaint is made. Electricity is to be supplied to all customers by meter, but this, like some of the other general regulations, may be varied by mutual agreement.

London, England.

(To be continued.)

American Electro-Therapeutic Association.

The following is the preliminary programme of the American Electro-Therapeutic Association, which will hold its fourth annual meeting at the New York Academy of Medicine, New York, Sept. 25, 26 and 27.

President's address, by Dr. W. J. Herdman, Ann Arbor, Mich.

Report of committees on scientific questions:

On Standard Coils, by Dr. Wm. Jas. Morton; on Standard Meters, by Dr. Margaret A. Cleaves; on Standard Electrostatic or Influence Machines, by Dr. Wm. Jas. Morton; on Constant Current Generators and Controllers, by Dr. W. J. Herdman; on Standard Electrodes, by Dr. A. Lapthorn Smith; on Stand and Electrode for Static Electricity, by Dr. Lucy Hall-Brown; on Electric Light as a Therapeutic and Diagnostic Agent, by Dr. Margaret A. Cleaves.

THE CONSTANT CURRENT.

Current Distribution, by Mr. W. J. Jenks; Physiological Effects, by Prof. A. E. Dolbear; Therapeutic Uses, General, by Dr. A. D. Rockwell; The Galvanic Current in Catarrhal Affections of the Uterus, by Dr. G. Betton Massey; Suites e'Loignees du Traitment Electrique Conservateur Gynæcologie, Grossesses Consecutives, by Dr. Georges Apostoli, Paris; Metallic Electrolysis, by M. le Docteur Georges Gautier, Paris; Dr. Wm. Jas. Morton, Dr. Margaret A. Cleaves, and Dr. A. H. Goelet, New York; Treatment of Urethral Stricture, report to date, by Dr. Robt. Newman; Diseases of the Eye, Electro-Therapeutics of, by Dr. L. A. W. Alleman; Notes on Goitre and Improvements in Apparatus for Treatment of Same, by Dr. Chas. H. Dickson; Diseases of the Throat, by Dr. D. S. Campbell; The Action of Electricity on the Sympathetic, by Dr. A. D. Rockwell; Diseases of the Nervous System, Treatment of Neuritis by the Galvanic and Faradic Currents, by Dr. Landon Carter Gray; Electric Sanitation, by Prof. John W. Langley; Physics of the Electric Light in Relation to Organized Matter, by Prof. John O. Reed; Hydro-Electric Methods, Physics and Appliances, by Mr. Newman Lawrence, London; Special Hydro-Electric Applications, by Dr. Margaret A. Cleaves; The Hydro-Electric Therapeutics of the Constant Current, by Dr. W. S. Hedley, Brighton, England.

INDUCTION CURRENTS.

Interrupted Currents, Physiological Effects, by Dr. W. J. Engelmann; Therapeutic Uses, General Faradization, by Dr. A. D. Rockwell; Gynæcological, by Dr. A. H. Goelet, Dr. H. E. Hayd and Dr. A. Lapthorn Smith.

SINUSOIDAL CURRENT.

Physics, by Mr. A. E. Kennelly; Physiological Effects, by Dr. W. J. Herdman and Dr. J. H. Kellogg; Therapeutic Uses, by Dr. Margaret A. Cleaves, Dr. Wm. Jas. Morton, Dr. J. H. Kellogg, Dr. Holford Walker and Dr. A. H. Goelet; Les Courants Alternatifs; Leur Transformation, Leur Mesure et Leurs Applications Therapeutics, by M. le Docteurs Gautier et Larat, Paris; on the Sinusoidal Current Method of Regulation, the E. M. F. and Resultant Current, by Dr. Lucy Hall-Brown, Brooklyn, N. Y.

STATIC AND STATIC INDUCED.

Physics, by Prof. Edwin J. Houston, Ph. D., Philadelphia; General Therapeutic Uses, by Dr. Wm. Jas. Morton; The Treatment of Chorea, by Dr. D. R. Brower; Static Induced, by Dr. Margaret A. Cleaves; High Frequency Currents derived from Static Machines as per Methode d'Arsonval, by Dr. J. H. Kellogg.

IN MEMORIAM.

Dr. Wm. F. Hutchinson, Providence, R. I.; Dr. John Chambers,

Indianapolis, Ind., by Dr. Robt. Newman, New York; Dr. Plymon S. Hayes, Chicago, by Dr. W. J. Herdman, Ann Arbor, Mich.

Design of Electromagnets for Specific Duty.—III.

BY E. R. CARICHOFF.

Fig. 1 shows the dimensions of a cast steel electromagnet, which, with an air gap of ⅛ in., pulls 1,200 lbs. when the exciting power is 4,800 amp. turns in either shunt or series coil. This gap is, for this particular case, the one which, multiplied by the pull of 1,200, gives a maximum, or 150 inch pounds. In case a movement over ½ in. instead of ⅛ in. is required, the plunger of the magnet may be attached to the short end of a 4 to 1 lever, at the long end of which

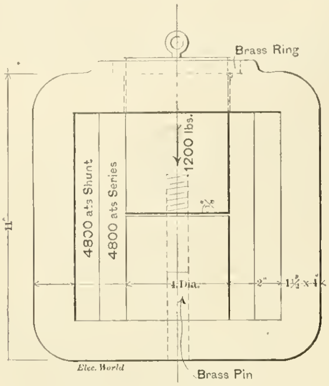


FIG. 1.

the travel will be ½ in., and the pull 300 lbs., or, as before, 150 inch pounds. If, however, the plungers are simply separated ½ in. the initial pull becomes about 132 lbs., which, multiplied by ½ in., gives 66 inch pounds or less than half what can be gotten by using the lever. All this supposes that the force to be overcome is fairly constant, or but slightly increasing. Of course, if the force to be overcome varies directly with the pull of the magnet, there is no need to bother about the air gap.

It is possible to get a direct pull of 300 lbs. at a distance of ½ in. by using the form of magnet in Fig. 2, which was suggested and adapted by Lieut. F. J. Sprague, of the Sprague Electric Elevator

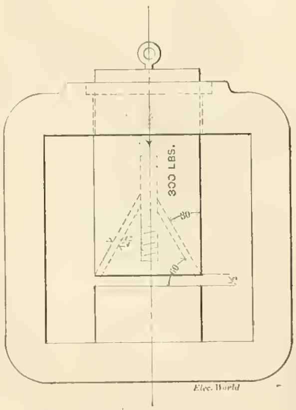


FIG. 2.

Company. The only change is in the air gap. With the angles there shown for the male and female cone plungers it is readily seen that the area of air gap is approximately doubled, and its length also doubled, while the reluctance is approximately the same as that of the arrangement in Fig. 1.

It is further readily seen that the travel of plunger is ½ in. instead of ⅛ in. as in Fig. 1.

As the reluctance of the circuit is approximately the same as in Fig. 1, the total number of magnetic lines is approximately the same. But as these lines are distributed over an air gap of double the area, and the force makes an angle of 60 with the direction of travel, the pull is only 300 lbs. at ½ in. This pull of 300 times ½ in. is, however, 120 inch pounds as before.

To change polar area and travel, keeping the reluctance approximately constant:

Suppose the approaching poles to be two cylinders with male and female conical extremities, as in Fig. 3.

If A is the cross-section and d the travel, and the proper length

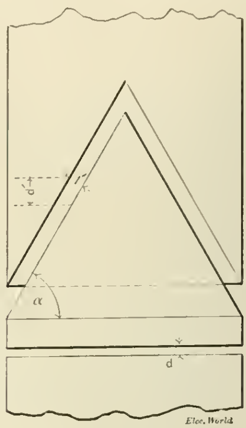


FIG. 3.

of air gap for a right section, A' is the polar area, l' the air gap length, and d' the travel when the angle at the base of the cone becomes a.

Condition of constant reluctance is $\frac{l'}{A'} = \frac{d}{A}$

But $A = A' \cos a$ and $l' = d' \cos a$;

Therefore, $\frac{d' \cos a}{A'} = \frac{d}{A' \cos a}$

whence $\cos^2 a = \frac{d}{d'}$, and $\frac{A'^2}{A^2} = \frac{d}{d'}$.

Thus, if we double the polar area in this way, the travel is increased four times.

We see that l' differs more or less from the true length of air gap according to position of conical surfaces.

Inductance of Lines.

Mr. G. M. Warner informs us that his attention has been called to a numerical error in his article under the above caption in The Electrical World of July 14, page 27, which may mislead readers. The calculation of the inductance drop for a given case by an arithemetical is made to give a result of 107.5 volts instead of 123 volts, as it should be. By changing, however, the number of cycles from 125 as given to 109, the error will be corrected, and all of the other numerical results given will remain unchanged.

Electrical Muscle Making.

Some recent scientific researches, which can doubtless be trusted, show that the weight of muscles of animals was increased 40 per cent. by a proper periodic application of an electric current, the growth being a true development of the muscle. According to this it will now be possible to increase to order size of any desired muscle without tiresome gymnastic exercises, by simply lying in a soft chair and having the current applied. This, we suggest, might be done at night by an automatic apparatus, thus saving time. Persons who are improperly developed may now be balanced or "trued up;" muscles shrunken by age may now be made plump again. Calves, which nature or exercise has failed to develop sufficiently, will now no longer be a drawback to wearing knee breeches, or the short bloomers of the female bicyclist. The question naturally suggest itself, what will happen if this process of developing muscles electrically is continued still longer? If some way is then found to develop the bones the manufacture of giants by electrical means will be an easy matter.

Dynamo Electric Machinery—II.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

STRUCTURAL ELEMENTS OF DYNAMO ELECTRIC MACHINES.

Dynamo machines as ordinarily constructed consist essentially of the following parts; namely:

(1.) Of the part named the *armature*, in which the E.M.F. is generated. This is generally a rotating part, although in some

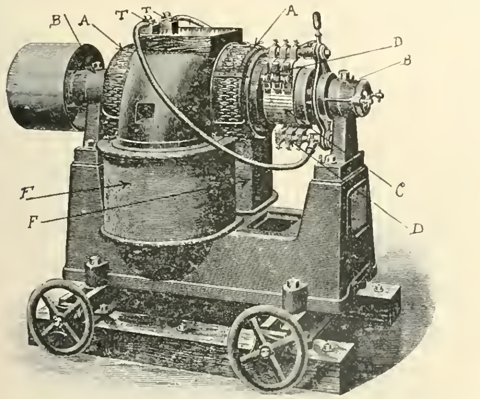


FIG. 1.—CONTINUOUS CURRENT BIPOLAR CONSTANT POTENTIAL GENERATOR.

machines the armature is fixed, and either the field magnets, or the magnetic field, revolve.

(2.) Of the part in which the magnetic field is generated. This part is called the field magnet and provides a *magnetic flux* through which the conductors of the armature are generally revolved.

(3.) Of the part or parts that are employed either for purposes of collecting and carrying off the currents produced under the E.M.F. generated in the armature, or for collecting and rectifying them,

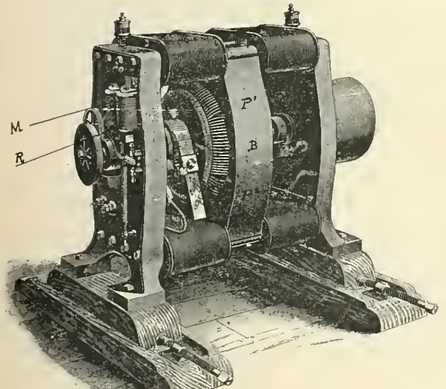


FIG. 2.—CONTINUOUS CURRENT BIPOLAR CONSTANT-CURRENT GENERATOR.

i. e., commuting them, and causing them to flow in one and the same direction as regards the external circuit. These portions are called respectively the *collecting rings*, when the current is not commuted, or the *commutator*, when the current is commuted.

(4.) Conducting collectors, consisting of a bundle of wire, or metallic gauze, or plates of carbon, pressed against the collecting rings or commutator, and connected with the circuit in which the energy of the machine is utilized. These are called the *brushes*.

In addition to the above parts, which are directly connected with the electrical functions of the machine, there are the necessary mechanical parts, such as the bearings, shaft, keys, base, etc., which also require attention.

The particular arrangement of the different parts will necessarily depend upon the type of machine, as well as on the character of the circuit which the machine is designed to supply.

It will, therefore, be convenient to arrange dynamo-electric machines into general classes, before attempting to describe the structure and peculiarities of the various parts.

10. Dynamos may be divided into the following classes—viz.:

(1.) *Constant-potential machines*, or those designed to maintain at their terminals, under all variations of load, a practically uniform E.M.F.

To this class belong nearly all dynamos for supplying incandescent lamps, and electric railroads.

Fig. 1. represents a particular machine of this type. A, A, is the armature, whose shaft revolves in the self-oiling bearings B, B. C is the commutator, and D, D, are sets of triple brushes pressing their tips upon the commutator. F, F, are the field magnets, wound

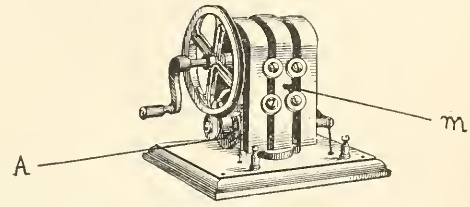


FIG. 3.—ALTERNATING CURRENT MAGNETO-ELECTRIC GENERATOR.

with coils of insulated wire. T, T, are the machine terminals, connected with the brushes and with the external circuit or load. The whole machine rests on slides with screw adjustment for tightening the driving belt.

Constant-potential generators are made in all sizes, and in various types.

(2.) *Constant-current* machines, or those designed to maintain an approximately constant current under all variations of load.

Constant current machines are employed almost exclusively for supplying arc lamps in series.

Fig. 2 represents a form of constant current generator. This is an arc light machine. It has four field magnets but only two poles, P^1 and P^2, connected by a narrow bridge of cast iron at B. At R is a

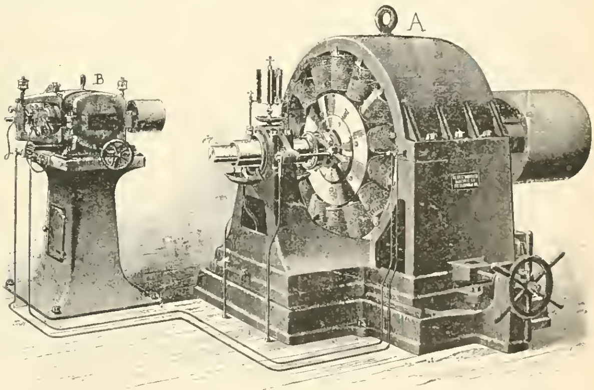


FIG. 4.—ALTERNATING CURRENT MULTIPOLAR SEPARATELY EXCITED GENERATOR.

regulating apparatus for automatically maintaining the constancy of the current strength by rotating the brushes back or forward over the commutator, under the influence of an electromagnet M.

Constant current machines are made for an output up to as many as 200 arc lights, i. e., about 10,000 volts and 9 amperes, or 90 kilowatts capacity. But such large sizes are exceptional.

11. Constant potential machines may be sub-divided into subclasses, according to the arrangement for supplying their magnetic flux—namely:

(a.) *Magneto-electric* machines, in which permanent magnets are employed for the fields.

The magneto-electric generator was the original type and progenitor of the dynamo or *dynamo electric* generator—but has almost entirely disappeared. It is, however, still used in telephony, the hand call being a small alternating current magneto generator, driven by a

handle. It is also used in firing mining fuses, also in some signaling and electro therapeutic apparatus.

Fig. 3 represents a form of magneto electric generator. M is a triple group of permanent magnets, and A is the armature.

(b.) *Separately excited* machines, in which the field electromagnets are excited by a separate electric source.

A particular form of separately excited generator is represented in Fig. 4.

Here a generator, A, has its field magnets supplied by a small generator, B, employed for this sole purpose. It is not necessary, however, that the exciting machine be used exclusively for excitation. Thus two generators, each employed in supplying a load, and each supplying the field magnets of the other, would be mutually separately excited.

Alternating current machines are frequently, and large continuous current machines in central stations are occasionally, separately excited. (To be continued.)

Some Facts About Polyphase Motors.*

BY LOUIS BELL.

In connection with the long distance transmission of power, most engineers will, I think, agree with me in the position that alternating current motors of some kind, and of alternating current, preferably the polyphase variety, are almost a necessity. We have been forced to their use by the exigencies of long distance service, which compel either the total abandonment of continuous current or its use under very embarrassing conditions.

There has, however, been a tendency to look upon the polyphase motor as a somewhat undesirable resort to which we have been driven by long distance work. Such, indeed, was my own belief from *a priori* reasoning, and before I had obtained that practical knowledge of the subject which can only come from personal experience both with the design and application of any class of apparatus. By such experience, and by the commercial demands which have been coming in with steadily increasing frequency, I have been forced into taking the position that the polyphase motor is intrinsically preferable to the continuous current motor for a vast majority of all the uses to which such machinery may be applied.

At present appearances indicate that not only will the polyphase motor displace direct current apparatus for most long distance transmission plants, but will prove a formidable competitor in all applications of motors to industrial purposes, and this, although the polyphase apparatus is the growth of only a few years, while the direct current motor is the outcome of more than a decade of experience.

We may, then, in instituting a comparison between polyphase and direct current motors, consider the various properties which a good motor of any kind must necessarily have. Mechanically speaking, we would all agree that it should be simple in construction, strong, not liable to frequent or considerable repairs, convenient in form and not excessive in weight. As regards its properties, it should in general run cool, stand overloading without serious danger, run at a nearly constant speed, or be capable of considerable variation in speed if necessary. It should be capable for certain uses of sudden and violent exertion, and of easily changing its direction of rotation. In a purely electrical way, it should be simple, efficient both at high and low loads, and should not take excessive amounts of current either in starting or in running.

This represents a difficult list of conditions to fulfil with any one motor, but I believe they can be met better by polyphase than by direct current machines. A direct current motor, for instance, of a given construction and reasonable weight, cannot run both at a constant speed, independent of load, in a particular case, and at the same time be capable of running at a wide variety of other speeds. It usually will not stand considerable overloads without sparking, and at the same time give a fair efficiency at low loads, and so one might go on piling up difficulties. The polyphase motor, too, cannot meet all these conditions with equal success, but examining them one by one, you will find that on the whole we can obtain very excellent results.

Taking up seriatim the desirable properties which I have enumerated, and applying them to polyphase motors, we find as regards the first count that their construction is singularly free from complexity. They consist in general of two concentric masses of lamination, forming respectively the fields magnet and armature. The armature is assembled on its shaft much as in direct current machinery, while the field laminations are held together by a clamping spider of very simple construction. The bearings are supported either on end spiders fitted to the field spiders by lathe work only, or on pillow blocks of the ordinary kind. Commutator and commutator connections there are none, nor should there be collecting rings except in rare instances. The armature need be exposed only to low voltages, and should preferably be wound with a comparatively small number of rather massive conductors, united at the ends either by a single plate or by very simple connectors, the latter form being preferable. The field winding is usually in a greater number of coils than is a direct current field winding, but each coil has a comparatively small number of convolutions, making the total winding by no means complicated.

In lieu of the starting rheostat of the direct current motor, we have a starting resistance which should preferably be placed within the armature, and consists of a few zigzags of metal united at one end and connected at the other to three or more contact pieces. A solid collar short-circuiting these contacts, and a forked lever to move the collar, completes the equipment, as I am accustomed to employ it. Its most noticeable feature is that the revolving armature, the most troublesome and delicate part of a direct current machine, is free from complication, and that it is almost as solid as if it were a solid mass of metal, and scarcely more liable to injury.

This very obvious simplicity of construction and mechanical strength is strong evidence of unusual freedom from repairs, and as a result of experience I have found that the induction motor is singularly free of liability to accidents of every kind. I have never succeeded even by the severest kind of experimental work in burning out a field coil or doing any serious injury whatever to a motor, although I have kept some of them on static torque tests in rapid succession for hours at a time, and have held them at rest and poured current through them until the leads burned off, the motor still remaining undamaged. If there is a test of extraordinary severity that I have not applied to induction motors, I have yet to learn of it. These properties are invaluable in commercial work inasmuch as they practically remove the danger of crippling the motor even under exceptionally unfavorable conditions.

As regards the convenience of the form of polyphase induction motors, I think an inspection of any of the types which have been brought out will render argument unnecessary.

The magnetic necessities of the case have led all makers of such apparatus in this country and elsewhere to adopt a species of barrel shape as the general outline of the motor, modified only in the proportions of diameter to length and in the adoption of one form or another of bearing. The tendency of this construction is to bring the centre of gravity of the machine very low, thus insuring unusual stability and freedom from general vibration. This form, too, enables one to place the motor in almost any position which is convenient in applying it, upside down, as a side bracket, and the like.

The largest installation of induction motors in the world, just put in operation in Columbia, S. C., aggregating over 1,200 h. p., is composed of inverted motors with their bases bolted to the ceiling timbers of the rooms.

As regards weight the abolition of any sparking limit to the output and the excellent magnetic material used might naturally be supposed to lead to motors of unusually light weight, and such is in fact the case. Sixty to seventy pounds per horse power in motors of moderate size is a figure easily reached without any sacrifice of efficiency, and if occasion requires these limits can be passed with great facility, 25 to 30 pounds of material per horse power being quite attainable in large units, while still retaining satisfactory general properties. I must say, however, that for most uses I do not consider extreme lightness either necessary or desirable, although it is important to be able to secure it if necessary. So much for the mechanical character of induction motors.

Electrically speaking, the case is just as favorable. Unless forced to a very large output per pound of weight, an induction motor will run quite cool, at a heating limit, in fact, below that of most direct current machines of similar weight and output. This advantage is mainly due to the very substantial character of winding which can be conveniently employed, and to the fact that the winding is distributed so that the losses in the copper are not localized, while the laminated character of the structure facilitates thorough ventilation. This freedom from excessive heating indicates that the polyphase motor can stand considerable overloading without any serious results, and experience has shown this to be the case. The worst that can really happen is that the motor may fall out of synchronism when the load is sufficiently great, thereby blowing the fuses in the primary line.

As sparking is obviated in this type of machine, it can readily be rated at such output as will give a proper limit of heating, and this output will in most cases allow from 30 to 60 per cent. of overload-

*A paper read at the Philadelphia meeting of the American Institute of Electrical Engineers.

ing before the machine will drop out of step. A wider range than this can be obtained if desirable, which it is generally not.

The limit of possible overloading fixes in a general way the possible static torque that can be obtained from a given machine, and this is apparently purely a matter of convenience in design, anything that can reasonably be required being quite attainable. There is no special difficulty in arranging polyphase motors for a starting torque four or five times the running torque, although this would be unnecessary except for severe hoisting and tramway work. At running torque the starting current taken may readily be no greater than the running current. From this it will readily be seen that a properly planned polyphase motor is easily capable of very great and violent exertions in a case of necessity. It will even endure complete reversal under full load within 10 or 15 seconds on motors of ordinary sizes, this time being sufficient for the machine to pass from full load in one direction to full load and speed in the other direction. This reversal is, as is well known, accomplished simply by reversing any two of the primary wires, the effect being to rotate the field in the opposite direction from the armature, thus causing an enormous rate of cutting lines of force, and consequently immense effort, causing the motor to stop and reverse.

SPEED VARIATION IN POLYPHASE MOTORS.

This subject has been for the most part in a rather hazy condition up to the present time. The induction motor has been generally known as non-synchronous, and such indeed it is. The name, however, has been frequently used in ignorance of the fact that an induction motor always tends toward synchronous running.

Under ordinary conditions the polyphase induction motor can be made to run at nearly constant speed independent of load, resembling in this respect a well designed shunt motor. A variation from no load to full load of 5 to 6 per cent. in speed would represent ordinary good practice, either in a shunt motor or a polyphase one, this limit being exceeded only in small motors or types which may be regarded as special. It is by no means difficult, however, so to design a polyphase motor that the speed shall possess very remarkable uniformity. This condition has been valuable in the Columbia plant previously alluded to. In this case tests of 17 motors showed a maximum variation in speed from an output of 75 h. p. to friction load of the motor, of only 2.2 per cent., individual motors showing slighter variations down to 1½ per cent.

The task of these particular motors is driving a cotton mill, hence the necessity for uniform speed. And this uniformity in speed is not greatly affected by variations in voltage, which would be quite sufficient to cause considerable speed variation in a shunt wound motor; in fact, the induction motor is remarkably insensitive to

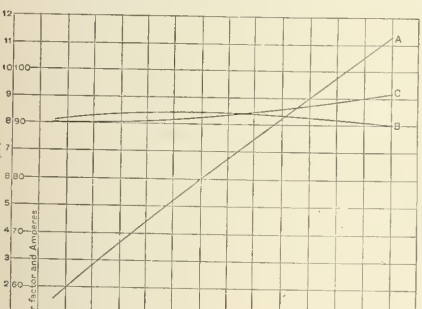


Fig. 1.

moderate variations in voltage, unless it is heavily loaded. This uniformity in speed has frequently been urged as an objection to the induction motor, barring its employment in cases where speed variation is necessary. This point is not well taken.

The induction motor cannot be made successfully to run at reduced speed by varying the primary voltage. Under these circumstances the output of the machine falls off somewhat more rapidly than the square of the voltage, so that only trifling speed variations are possible. It is a fact not generally known, however, that the speed of a polyphase motor can be varied with the same facility and within the same wide range as is possible in the case of a series wound continuous current machine, such as a railway motor. This is accomplished in the induction motor by a rheostat in the secondary circuit, just as it is accomplished in the series motor by a rheostat in the main circuit. Thus equipped, the two machines behave almost exactly alike. The speed at constant torque can be made to vary from full speed down to almost no speed, thus simulating the action of the series motor in the closest possible fashion. At any given speed an increase or decrease of the torque will decrease or increase the speed substantially alike in both classes of motors. In both, too, the efficiency is initially similar and falls off in practically the same ratio. A non-inductive resistance is necessary in case of the polyphase motor, an inductive one throwing the armature current so far out of phase as to interfere with the proper action of the motor.

Fig. 1 gives an excellent idea of the behavior of a polyphase motor with resistance in the secondary circuit.

Curve A shows the speed and output of a certain motor under these circumstances. It was a four-pole machine operated at 50 cycles per second, and the initial speed was reduced to 1,400 by

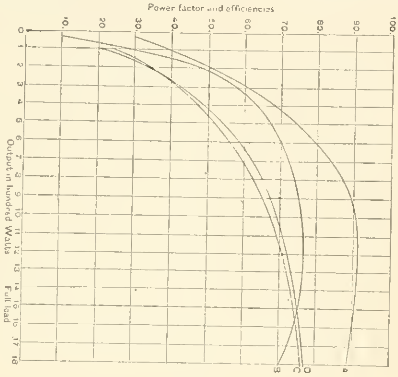


Fig. 2.

the resistance of the leads reaching across the room to the rheostat, composed of loops of manganin strip which could be systematically varied. It will be seen that the word curve is almost a misnomer, the ratio between the speed and output at constant torque being almost a linear function, even when the speed fell to as low as 150 revolutions per minute. It was not carried lower than this only because of lack of adaptability in the rheostat. No series motor could show a more satisfactory result.

Curve B shows the power factor under these varying conditions. It is high at all loads and speeds, varying slightly, with a maximum at about half speed.

Curve C shows the variation in current. This, as can be seen, is almost constant, falling off slightly at the lower speeds, the voltage being uniform throughout the test.

Speed variation by this method is not as efficient as might be wished, but still compares favorably with that obtained in a series motor with rheostatic control. Some modified methods of control promising a somewhat better efficiency have been suggested, but it seems probable that in the net result we shall find that continuous current and polyphase motors are about on a par in this respect. It should be noted that in continuous current motors, speed variation by weakening the field is only practicable within a very limited range, and requires an abnormally heavy motor. I think that with a similar change in design the polyphase motor could be made to operate nearly as well by change in its field strength. An efficient speed variation through a very wide range is attainable in either class of machine only by extraordinary means, as an elaborate combination of direct current machines, or frequently changing devices in the polyphase machines. From what has been said it will be apparent that the polyphase motor is perfectly capable of a complete control of speed on the same terms generally obtained with continuous current motors.

COMPARISON OF A POLYPHASE AND CONTINUOUS CURRENT MOTOR.

Fig. 2 gives a striking comparison between the properties of the two classes of machines under consideration.

The polyphase motor selected for comparison is of 2 h.p. output, representing the average small motor to be found in central station practice. This particular size weighs 218 lbs. complete, and runs at a speed of about 1,400 revolutions per minute on 50 cycles, loaded. It is relatively neither better nor worse than polyphase motors of other sizes, as may be seen by reference to the curves in my previous paper on this general topic. The power factor in this

case rises quite sharply, reaching 86 per cent. at half load, and through most of the working range of the motor remains at or near 90 per cent., nearly 91 per cent. as a maximum. The efficiency has its maximum a little [under full load of the motor and reaches nearly 77 per cent., being 75 per cent. at full load. Both power factor and efficiency hold high values from half load up and do not fall off seriously until some distance below half load.

Contrast with curves A and B belonging to the polyphase motor, curves C and D; the former is the efficiency curve of a 2 h.p. 500 volt motor of one of the well-known American makes, and curve D is a similar curve for 2 h. p. 110 volt motor of European manufacture. These are not selected curves, but were the two completest available. Both these curves, C and D, show remarkable similarity. Neither of the motors sparked seriously at full load, the load limit being set rather by the heating. Both curves rise slowly and attain their maximum values at some point beyond the available load of the machine. At full load the efficiency is substantially the same as that of the triphase motor. At low loads it is noticeably worse. I think C and D are fair average machines. In tests of a wide variety of motors, some higher and some lower efficiencies would be found. Such, too, would be the case in testing a variety of polyphase motors. In fact the mate of the triphase motor shown, sent through the factory at the same time, showed about 1½ per cent. higher efficiency, but a complete test was not attainable, as the machine had to be immediately shipped. A comparison of these curves will render it evident that it is quite practicable to produce a polyphase motor having an efficiency fully equal to that of direct current motors of similar size, and I think the tendency will be towards

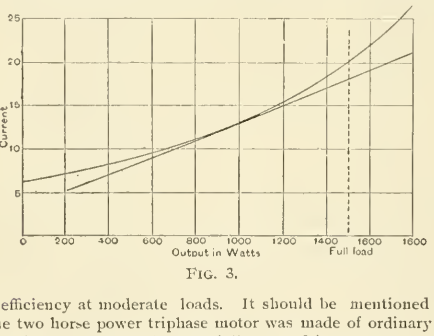


FIG. 3.

better efficiency at moderate loads. It should be mentioned here that the two horse power triphase motor was made of ordinary good armature iron, not selected or specially treated in any way.

Finally, let me call sharp attention to curve 3, which shows the effect of the power factor which, I regret to say, has been talked about not wisely but too well, in most of the discussions pertaining to polyphase apparatus. Two curves in Fig. 3 show the total current in the line in the 2 h.p. triphase motor and the 110 volt continuous current motor above mentioned. The current curve of the continuous current machine is nearly a straight line—that of the polyphase machine is almost tangent to it and slightly concave upward. A noticeable fact displayed is that throughout the ordinary working range of these two motors the currents were substantially equal, the existence of the power factor in the polyphase motor being only noticeable at very low loads and at overloads. This comparison should be a sufficient answer to the charges of excessive current that have so often been made against the polyphase machines. In a bad polyphase motor they would have foundation in fact. In a rather good one the net effect of the lagging current is trifling. It should further be noted that the current in this triphase motor at friction load is only about 30 per cent. of current at full load, and of this only 30 per cent. represents loss of energy. This is in marked contrast with the results obtained from a foreign triphase motor of similar size exhibited at the World's Fair, in which the no load current was nearly equal to that at full load and the power factor at full load was barely over 50 per cent.

In this brief discussion of some of the properties of modern polyphase motors I have endeavored to show how nearly they fulfill the conditions which may be regarded as desirable in electric motors in general. That they do so as well, if not better, than the continuous current machines of similar capacity I believe that I have satisfactorily shown.

The demand which certainly is arising for polyphase motors for general power purposes based on their intrinsic merits indicates that the older type of machinery has found a dangerous rival, all questions of long distance transmission aside.

Solar Electrical Energy Not Transmitted by Radiation.

Under the above caption Dr. M. A. Veeder, of Lyons, N. Y., has a paper in Vol. II. of the Rochester Academy of Science, in which he maintains that terrestrial magnetic perturbations are not of thermo-electric origin and have nothing whatever to do with heat or light radiations, adducing in support the facts that the maximum effect of magnetic storms are recorded on the dark side of the earth and that the auroras accompanying such storms, as seen in the Arctic regions at times, when daylight does not interfere with their observation throughout the entire twenty-four hours, appear on the side of the earth away from the sun.

It is true, Dr. Veeder states, that light rays may have electrical effects, as, for example, when they come in contact with selenium. This signifies nothing more than that ether pulsations may produce a certain amount of superficial atomic readjustment such as appears in photography. If, on the other hand, chemical or electrical action in their turn originate light rays, these have no power to transmit the very force on which their origin depends. Were it otherwise, an electric light would be a deadly thing. If the power of the current traversing the carbons were conveyed by radiation to surrounding objects, it would cause serious inconvenience if not death to any individual so unfortunate as to be exposed to its rays. As a matter of fact, however, there is no reception or dispersion of electric force by radiation, certain small vibratory motions of the ether only being conveyed by this means which produce certain electrical effects mechanically, which are wholly insignificant as compared with the force of the dynamo traversing the conducting wire.

All that we know about electricity, according to the views of Dr. Veeder, is that it is a property of atoms which after the analogy of chemical affinity causes them to combine pole to pole in such a manner as to satisfy what may be termed their electrical valency or power of entering into definite forms of adjustment in respect to each other. As well might we deny the existence of the attraction of gravitation, which does not appear to have any conceivable relation to ether waves, as to refuse to admit the existence of other forms of attractive force which may likewise be independent of ether waves and atomic oscillations of every sort. If only electrical currents were concerned it would be a question of motions, perhaps. The final outcome of electrical action is, however, an adjustment of stresses in particular directions having reference to poles and lines of force, so as to produce a state of equilibrium and consequent cessation from motion. To Dr. Veeder such a view appears to involve far greater difficulties than those sought to be explained. There is the question as to what must be the character of the motions of the ether that could accomplish such results, and the further question as to the manner in which these motions are sustained. With our present knowledge it seems preferable to assume, as the starting point, the existence of properties inherent in the atoms and independent of motion of any sort. To do otherwise than this is to resolve not only the properties of matter but matter itself into a question of wave length, the very existence of matter being unthinkable apart from that of its properties.

The following hypothesis concerning the whole process of the origination of magnetic storms is offered by Dr. Veeder: Particular portions of the sun's surface and cooler immediate surroundings are electrified by what has every mark of being volcanic action. The motion of rotation of the sun carrying forward these charged portions of its surface develops currents dynamically which act inductively along lines of force wherever there is conducting material within their scope. There is no conveyance by radiation or in a manner similar to that in which heat and light are emitted from the sun. The laws governing the process are entirely different from those of radiation and have reference to the principles of conduction as they appear under the conditions existing in interplanetary space. It is a mode of solar action that is distinct and that must be considered by itself. The final outcome of the temporary, sub-permanent and permanent effects of the electro-magnetic impulses thus originated and distributed is a magnetic system comprising within its scope the entire solar system and depending upon the properties of matter rather than of an ether simply. With this clue it becomes possible to trace out the modes of action and reaction and transference of stores of electrical energy in such manner as could not otherwise be done. Following this line of investigation it is already becoming quite certain that electromagnetic forces play a much more important part in the economy of the solar system than has heretofore been supposed. The physicist who has a clear apprehension of the nature of the properties of matter is the coming man in astronomy. The geometer has had his day.

Action of a Transformer with a Condenser in Parallel with the Secondary.

BY FREDERICK BEDELL AND ALBERT C. CREHORE.

In this article will be discussed the action of a transformer, across the secondary terminals of which is shunted a condenser. The condenser is, therefore, in parallel with the secondary load, which is supposed to be non-inductive, as would be the case with incandescent lamps. The problem will be treated in the same way as the various transformer problems given by the writers in a series of articles entitled "Theory of the Transformer," in The Electrical World, 1893. In these previous papers the action of a transformer has been investigated under various conditions, when supplied with a constant current and when supplied with a constant potential, the results for the latter case being in all instances derived from the results of the former, inasmuch as the graphical construction is simpler for the constant current case than for the case with constant primary electromotive force. The method for converting constant current diagrams into those for constant potential has been given for so many of these previous problems that in this discussion we will confine ourselves to transformers with constant primary current.

There are introduced here two new features not discussed in the previous articles: First, the presence of a condenser in combination with a transformer, and, second, a shunt circuit in parallel with the secondary circuit. Hitherto the secondary has been considered as a single circuit, all the current from the secondary of the transformer passing through the secondary load. It is now proposed to consider the simplest case of a divided circuit,

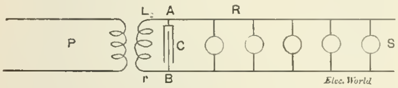


FIG. 1.

where the transformer secondary current divides, part passing through the condenser and part through the external resistance.

This problem is rendered easy by the use of graphical methods, for, although in the transformer we have mutual induction, yet, to construct the constant primary current diagram, we know that the impressed electromotive force upon the transformer secondary is equal to $M\,\omega\,I_1$ and is therefore a constant. This consideration reduces the matter to the simple case of the transformer circuit in series with a divided circuit; there is a constant impressed electromotive force, independent of the mutual induction of the transformer. Since this class of circuits has been already fully discussed in the writers' "Alternating Currents," Part II., it is thought to be sufficient to give one or two representative cases, where a condenser is used in combination with a transformer; and the method followed in this problem points to some general principles which will be useful in the many other similar problems.

The diagrammatical representation of the combination of transformer and condenser, which it is our purpose to investigate, is shown in Fig. 1. The primary circuit is denoted by P, and secondary by S. The condenser, C, is shunted between the terminals, A and B, of the secondary. The line resistance is R; the resistance and reactance of the secondary of the transformer are r and $L_2\omega$ respectively.

Since the impressed electromotive force upon the transformer secondary is $M\,\omega\,I_1$ we may, if we choose, represent the secondary circuit apart from the primary, as in Fig. 2. Here $M\,\omega\,I_1$ is a

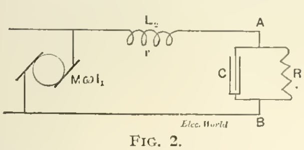


FIG. 2.

generator supposed to give an impressed E. M. F. $M\,\omega\,I_1$ exactly like the transformer, but supposed to offer no impedance to the current.

There are two methods which present themselves by which the solution of this problem may be obtained. One is the partly analytical and partly graphical, and the other entirely graphical. The former method will first be briefly indicated. The latter forms more especially the subject of this article.

DIAGRAM ESTABLISHED ANALYTICALLY.

The electromotive force $M\,\omega\,I_1$ impressed upon the circuit is the geometrical sum of two components; one to overcome the transformer impedance, equal to $I_t\,(r^2+L_2^{\,2}\,\omega^2)^{\frac{1}{2}}$; the other to overcome the combination of condenser and resistance in parallel between the points A and B (Fig. 1). The equivalent resistance and capacity of circuits in parallel has been developed in the general case* where there are any number of branches to the divided circuit, and they may be thus expressed: The equivalent resistance is

$$R' = \frac{A}{A^2 + B^2\,\omega^2}\,.$$

The equivalent capacity C′ may be found from the expression

$$\frac{1}{C'\omega} = \frac{B\,\omega}{A^2 + B^2\,\omega^2}\,,$$

$$\text{where } A = \Sigma\,\frac{R}{R^2 + \dfrac{1}{C^2\,\omega^2}}$$

$$\text{and } B\,\omega = \Sigma\,\frac{C\,\omega}{C^2\,R^2\,\omega^2 + 1}\,.$$

The summation gives one term for each of the branches. In the present case, where there are but two branches, and one branch contains no capacity, the other no resistance, the values of A and $B\,\omega$ reduce to

$$A = \frac{1}{R}\,;\ \text{and } B\,\omega = C\omega.$$

This gives the values of R' and $\frac{1}{C'\omega}$:

$$R' = \frac{R}{1 + R^2\,C^2\,\omega^2}\,;\ \text{and } \frac{1}{C'\omega} = \frac{C\,\omega\,R^2}{1 + R^2\,C^2\,\omega^2}\,.$$

The impedance of the combination of the divided circuits is

$$\left(R'^2 + \frac{1}{C'^2\,\omega^2}\right)^{\frac{1}{2}} = \left(\frac{R^2 + C^2\,\omega^2\,R^4}{(1 + C^2\,\omega^2\,R^2)^2}\right)^{\frac{1}{2}} = \frac{R}{(1 + C^2\,\omega^2\,R^2)^{\frac{1}{2}}}$$

The current through the transformer may now be found as follows: Replace the condenser and resistance branches by a single circuit, having resistance R' and capacity C', and we have now a simple circuit whose total impedance is

$$\left\{ (r + R')^2 + \left(\frac{1}{C'\omega} - L_2\,\omega\right)^2 \right\}^{\frac{1}{2}}.$$

The angle of phase difference between the electromotive force $M\,\omega\,L_1$ and the transformer current is

$$\text{arc tan}\ \frac{\left(\dfrac{1}{C'\omega} - L_2\,\omega\right)}{r + R'}.$$

Referring to Fig. 3, lay off OB equal to $M\,\omega\,I_1$ and make the angle BOV equal to the angle of phase difference obtained in

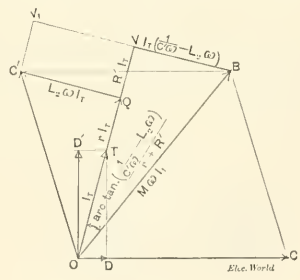


FIG. 3.

the last equation above. Draw BV perpendicular to OV. Let I_t denote the total current through the transformer secondary. Then OV equals $(r + R')\,I_t$, and $\text{BV} = \left(\frac{1}{C'\omega} - L_2\,\omega\right) I_t$. Divide OV by $(r + R')$ and obtain the current I_t, represented by OT. Also divide OV into two parts, OQ and QV, proportional to r and R' respectively. Then OQ is that portion of the impressed E. M. F. used for the transformer resistance. Draw QC′ perpendicular to OQ, in advance of it, and make it equal to $L_2\,\omega\,I_t$. Then OC′ is that portion of the impressed E. M. F., OB, which goes to overcome the transformer secondary impedance. Since OB is the sum of *two* components, OC′ for the transformer impedance, and a second component for the combination circuit, it follows that C′B, equal to OC, is the E. M. F. at the terminals of the divided circuit. The line current, OD, is necessarily in phase with the E. M. F., OC, at its terminals, and the condenser current, OD′, is a right angle ahead of OC. From T draw a perpendicular upon OC and upon OD′, and we have the transformer current, OT, the sum of the currents OD and OD′ in the line and condenser.

* See "Alternating Currents," pp. 303-308.

Thus, by the consideration of the equivalent resistance and capacity of divided circuits, we may easily find the relation between the E. M. Fs. and currents in the various branches. This, however, is not the way of looking at the problem that will most obviously give us the means to draw diagrams illustrating the manner in which the various quantities concerned change as we alter some one quantity. The method that lends itself more readily to this is, in our judgment, the entirely graphical method, which will now be explained.

DIAGRAM ESTABLISHED GRAPHICALLY.

It is our aim to construct the diagrams representing the changes which occur when the primary current is constant, while any one quantity, as, for instance, the line resistance or condenser capacity, is varied. As already explained, the constant current diagrams naturally precede the constant electromotive force diagrams, and are usually much simpler, inasmuch as the variations usually take place upon the arc of a circle. The constant E. M. F. diagrams may be directly derived from the constant current figures.

A constant primary current gives a constant impressed E. M. F., $M \omega I_1$, upon the transformer secondary. Any variation in one of the quantities of the secondary circuit will naturally cause the E. M. F. at the condenser terminals to change. If this condenser potential were to remain constant, it would be a very simple matter to draw the diagram of variations. It is proposed, first, to construct diagrams representing constant condenser E. M. F., and then to show how these may be changed to represent constant transformer impressed E. M. F.

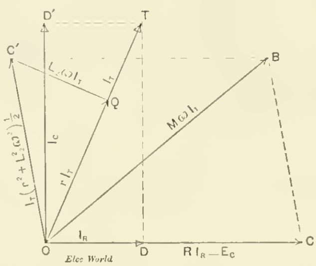


FIG. 4.

Let OC, Fig. 4, represent the constant E. M. F. at the condenser terminals, A and B (Fig. 1). Then the condenser current, OD', is a right angle in advance of OC, and equal to $C \omega$ times OC. The line current, OD, has the direction of the electromotive force OC, and is equal to OC divided by R. The transformer current, OT, is the geometrical sum of OD and OD'. The E. M. F. for the transformer resistance is OQ, equal to OT times r. The E. M. F. for transformer reactance is QC', equal to $L_2 \omega I_1$, a right angle in advance of OT. The E. M. F. for transformer impedance is OC', the sum of OQ and QC'. The total impressed E. M. F. in the transformer is the geometrical sum of the components OC and OC', which is OB. This completes the diagram, and gives a figure like Fig. 3, obtained from the idea of equivalent resistance and capacity.

(To be continued.)

Suggestions for Transit Systems.—IV.*

BY S. D. MOTT.

REDUCTION OF SPEED WITHOUT GEARS.

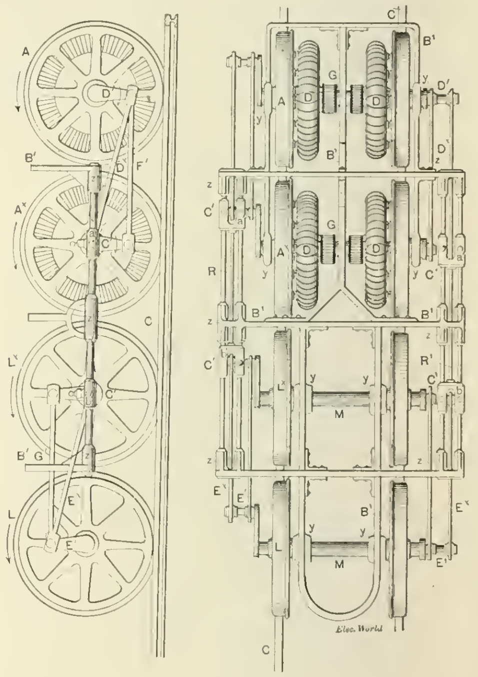
In the early days of electric traction development, one of the mechanical problems presented was the reduction of speed of the electric motor to the normal speed required for street car service. A mechanical solution of this problem necessarily involved a second important factor—that of overcoming the "vis inertia" of the vehicle by the small power or starting torque of the motor on the principle of the simple lever.

The first step of adaptation of the motor to the problem presented was, as would seem natural, loose belts and their tighteners and reduction gears, either cog or frictional. Belts and their adjuncts proved to be of little utility, and gears at that early period were far from what was desired.

In 1880 the writer devised a car equipment, the leading feature of which was a direct connection of the armature to the car axle, in combination with a form of car starting device, with the thought that the motors would prove adequate to propel and control the motion of a car or train after being started by extraneous or means other than electrical—the car was started mechanically and electrically controlled while in motion.

This arrangement, though simple, did not commend itself as commercial. I conceived there must be a way to multiply the small power of a motor into a greater force, sufficient for car driving, in a way analogous to the simple lever or closed train of gears, when great resistance or weight is overcome by an insignificant force. This presented itself as only a question of relative speeds for a given time, and there was plenty of speed, and to spare, but comparatively small pull or torque. The problem was to reverse this in a way that was practical, and to attain this end I was led to utilize the reaction of the motor; *i.e.*, allow the two elements of the motor, the armature and the field revolution, and then bring the dual reverse motion to bear at the same point of traction or another point, through other axles and wheels.

This, it was apparent—by the mechanical law that, in a closed train of mechanical elements, relative power or leverage changes, and is governed by relative speeds—would give double the pull of



FIGS. 1 AND 2.

the motor at the point of traction, other things being equal, because the two elements of the motor had twice the relative speed as when one element only revolved, and, *a priori*, *one* pound torque of the motor would, on the principle of the simple lever, give *two* pounds pull to the car.

The writer then devised a number of mechanical methods for reduction to practice. On some, gears were used; in others, no gears were used; and in still others, for special purposes, as bridge systems, etc., a cable was used. In some of these combinations, the statical, or moving pull, of the motor was capable of being still further increased by the purely physical action of the current up to any degree of useful application. The drawings illustrate two methods of motor equipment where the armature is directly connected to the axle, and at the same time the torque, or statical pull, is doubled without gears. This may appropriately be called a reacting or reciprocal driving equipment.

Fig. 1 is a side elevation and Fig. 2 a plan of such an equipment having four motors and four pairs of drivers, two pairs being motor drivers and two pairs reciprocal drivers, taking the reaction of the armature and reversing it through the connecting rods, parallel rods, crank pins, frame, bearings, etc. To avoid dead centres, the

* For parts I., II. and III. of this article see The Electrical World of April 28 1894, p. 576; May 26, 1894, p. 719, and June 30, 1894, p. 873.

cranks on one side are set at ri ht angles to those on the opposite side—in fact, if the connecting rod R or R′ be substituted in the imagination for the piston rod of a locomotive, and the four motor wheels, or the four reacting wheels, be considered by themselves, there appears exactly the mechanical combination of the New York Elevated Railway locomotives, with the exception, of course, that the wheel drives the piston rod electrically, instead of the piston driving the wheels by steam.

The armatures are fixed to the axles, and the field magnets revolve with the wheels on the track. The four armatures are not

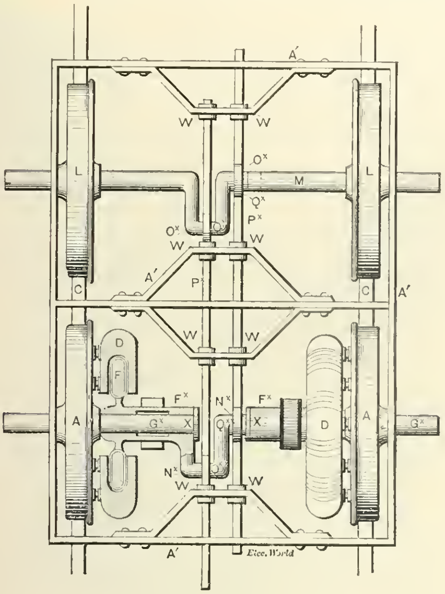


Fig. 3.

independent of each other, but are a mechanically closed train, while the fields are rotatively independent of each other, and the wheels with which they are connected will round curves without skidding the track.

Figs. 3 and 4 illustrate another method of reciprocal driving without the intervention of gears, having the same end in view as Figs. 1 and 2, but in this case using two pairs of drivers, instead of four.

Referring to these figures, A A are the motor wheels and drivers,

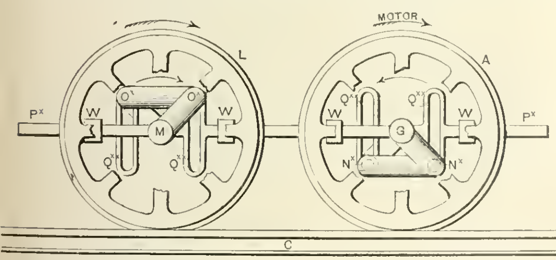


Fig. 4.

and L L are reciprocal drivers. In the driving wheel axle, M, are formed two cranks, O^x O^x, arranged at right angles. p^x p^x are reciprocating yoke bars, which have bearings at W W in a frame A′, mounted on the axles as shown. In the yoke bars are formed vertically arranged yokes, O^x O^x, in which play bearing boxes on the cranks of axle M. The axle G of the motor wheels is divided, and the divisions have heads, X X, on their inner or adjacent ends. On these divisions of axle G^x are rotatively mounted sleeves, F^x, which are connected by cranks, N^x N^x, formed with or secured rigidly to said sleeves. These cranks, N^x, have the same throw as cranks O^x, correspond to the latter in arrangement, as shown, and are set at right angles with each other. The yoke bars, P^x, are provided with yokes, Q^{xx} Q^{xx}, precisely like yokes Q^x, in which play bearing boxes or cranks N^x. The armatures, F F, are fixed each to a sleeve, F^x, and they rotate with said sleeve. The field magnets are fixed to and rotate with the wheels A. The long sleeves, F^x, rigidly connected by the cranks, N^x, so support the divided axle as to produce therein the effect of continuity, so far as stiffness and strength are concerned, but each wheel may act independently of the other.

Practical Notes on Dynamo Calculation,—XIII.

BY ALFRED E. WIENER.

28. Dimensioning of Commutator.

a. Diameter and Length of Brush Surface.

In low potential machines with small number of divisions, the thickness of the substructure determines the diameter of the commutator; in high potential machines, however, especially those of multipolar type, where the number of commutator segments is very great, the width, at top, of the commutator bars, their number, and the thickness of the insulation between them fix the outside diameter.

The bars must be large enough in cross section to carry the whole current generated in the armature without undue heating, and shall continue so after a reasonable amount of wear. They must be of sufficient length to allow a proper number of brushes to take off the current.

The same brush contact surface may be obtained by employing either a broad thin brush on a small diameter commutator, or a narrow thick one on a large diameter, the number of bars being the same in both cases, their width, consequently, larger in the latter case. With larger diameter and greater consequent peripheral velocity there will be more wear of both brushes and segments, and greater consumption of energy due to the increased friction of the brushes.

The segments are usually made of copper (cast, rolled or forged), phosphor bronze, or gun metal, sometimes brass, and even iron being used; the materials for the substructure are phosphor bronze, brass or cast iron.

From all this it will be obvious that a general formula for the diameter of the commutator cannot be established, and that, on the contrary, this dimension has to be properly chosen in every case with reference to the armature diameter to the design of the commutator, to the materials employed, to the strength of the substructure, or the thickness of the bar, respectively, and, finally, with reference to the wear of the segments.

The commutator diameter being decided upon, the size of the brushes can now be calculated, as shown in Section 29, and, from this, the length of the commutator can be found.

In order to prevent annular grooves being cut around the commutator, the brushes ought to be so adjusted that the gaps between those in one set do not come opposite the gaps in the other set.

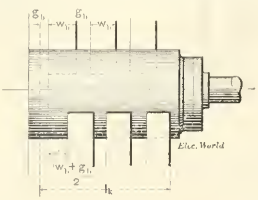


Fig. 39.

Denoting, Fig. 39, the width of each brush by w_b, their number per set by n_b, and the gap between them by g_b, we consequently obtain the total length of the commutator brush surface from:

$$l_k = \left(n_b + \frac{1}{2}\right) \times (w_b + g_b) \qquad (71)$$

This length of brush surface should be available even after the commutator has been turned down to its final diameter; the original diameter must therefore have a somewhat larger contact length. An addition to l_k of from ¼ to 1 inch, according to the depth of the bar, is thus necessitated.

b. Commutator Insulations.

In a commutator the insulation has to form a part of the general structure, and has to take strain in common with other material used; from its natural cleavage and hardness, therefore, *mica* is particularly suitable for commutator insulations, and is, in fact,

almost exclusively used for this purpose, only asbestos and vulcanized fibre being employed in rare cases.

The thickness of the commutator insulation ought to be proportional to the voltage of the machine, and, for the various positions with reference to the bars, see i, i', i'', Fig. 40, should be selected within the following limits:

TABLE XXXIV.—COMMUTATOR INSULATIONS FOR VARIOUS VOLTAGES.

	Up to 300 Volts.	400 to 750 Volts.	800 to 3,000 Volts.
Side insulation (i)	.020″ to .030″	.030″ to .040″	.040″ to .060″
Bottom insulation (i')	$\frac{3}{64}$ " $\frac{3}{32}$	$\frac{1}{16}$ " $\frac{1}{8}$	$\frac{3}{32}$ " $\frac{3}{16}$
End insulation (i'')	$\frac{1}{16}$ " $\frac{3}{32}$	$\frac{3}{32}$ " $\frac{1}{8}$	$\frac{1}{8}$ " $\frac{3}{16}$

29. Brushes and Current Leads.

a. Brushes.

The best breadth of the brush contact surface, with reference to the prevention of excessive sparking at the commutator, is that

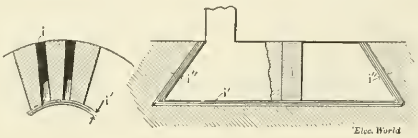


FIG. 40.

equal to the width of one commutator segment, Fig. 41. If, however, this would make the commutator too long, two bars may be covered by the brush, as in Fig. 42.

In the former case not more than one armature coil is short circuited at any time, while in the latter case two coils, at times, are simultaneously short circuited under each set of brushes.

The circumferential breadth of the brush contact may accordingly be expressed by

$$b_k = \frac{d_k \times \pi}{n} - i \qquad (72)$$

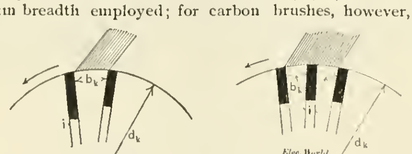
or, respectively, by

$$b_k = 2\left(\frac{d_k \times \pi}{n} - i\right) \qquad (73)$$

where:

b_k = circumferential breadth of brush contact, in inches;
d_k = diameter of commutator, in inches;
n = number of commutator divisions;
i = thickness of side insulation, in inches (see Table XXXIV).

For copper brushes the result obtained by (73) should be the maximum breadth employed; for carbon brushes, however, where



FIGS. 41 AND 42.

the coils are short circuited through the comparatively high resistance of the carbon, b_k may be chosen so as to cover three bars of the commutator.

Having decided upon b_k by either one of the above formulæ (72) or (73) respectively, or having selected an intermediate value, the width of the contact area, and subsequently the width of the brushes can be found for a given current output of the dynamo by providing contact area in proportion to the current intensity. In order to keep the brushes at a moderate temperature, and the "loss of commutation" within practical limits, the current density of the brush contact should not exceed 150 to 175 amperes per square inch, in case of copper brushes (wire, plate, and gauze), and 30 to 35 amperes in case of carbon brushes.

The total axial width of the brush surface can, consequently, be expressed by

$$w_k = \frac{C}{150 \times b \times b_k} \qquad (74)$$

for copper brushes, and

$$w_k = \frac{C}{30 \times b \times b_k} \qquad (75)$$

for carbon brushes.

w_k = total axial width of brush contact surface, in inches;
C = total current output of dynamo, in amperes;
b = number of pairs of brush-sets (usually either $b = 1$, or equal to the number of pairs of poles, $b = P$).

For the purpose of securing a good contact, each contact surface should be subdivided into a set of n_b individual brushes, of a width w_b each, not exceeding 1½ to 2 inches. In small machines, where one such brush would suffice, it is good practice to employ two narrow brushes, even as low down as ⅜ inch each, in order to facilitate their adjusting or exchanging while machine is running.

b. Current Leads.

Care must also be exercised in the proportioning of those parts of a dynamo which serve to lead the current collected by the brushes to the external circuit. For, if material is wasted in these, the cost of the machine in unnecessarily increased and if, on the contrary, too little material is used, an appreciable drop in the voltage, and undue heating will be the result.

In order to guide the design of such parts, among which may be classed brush holders, cables, conductor rods, cable lugs, binding posts and switches, the following Table XXXV. has been prepared, which contains practical averages of the current densities to be employed for cross section and contact surface of the various materials used:

TABLE XXXV.—AVERAGE CURRENT DENSITIES FOR CROSS SECTION AND CONTACT SURFACE OF VARIOUS MATERIALS.

	Material.	Current Density.	
		Square Mils per Amp.	Amps. per Square Inch.
Cross section	Copper wire	500 to 800	1,200 to 2,000
	Copper rod	800 " 1,200	800 " 1,200
	Copper wire Cable	600 " 1,000	1,000 " 1,600
	Copper casting	1,400 " 2,000	500 " 700
	Brass casting	2,500 " 3 300	300 " 400
Brush contact	Copper Brush	5,700 " 6,700	150 " 175
	Carbon Brush	28,500 " 33,500	30 " 35
Sliding contact	Copper — copper	10,000 " 15,000	67 " 100
	Brass < copper / brass	20,000 " 25,000	40 " 50
Screwed contact	Copper — copper	5,000 " 8,000	120 " 200
	Brass < copper / brass	10,000 " 15,000	67 " 100

(To be continued.)

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—I have read with interest the comments reproduced in your columns from the London "Electrician" on those American engineers who are striving to build alternators giving perfect sine curves. The editor of that journal seems to take it for granted that such efforts are the result of being theory mad. I can assure you that in our case at least, although we do feel considerable respect for theory, our efforts were prompted solely by our experience of the advantages to be gained by such a construction. It may surprise the learned editor that we have found, for instance, that a motor which developed 40 h.p. when driven by a generator giving approximately sine waves was practically inoperative, scarcely able to turn itself over when unloaded, when working with an alternator of the same nominal frequency, but with very irregular waves. We have even found that there may be as much as 10 per cent. difference in the iron losses in transformers in favor of the sine wave alternator as compared with one of the ordinary irregular wave machines. The theory in the case of the motors is very simple, but as it has been more than once published, and as the editor of the "Electrician" calls in question its relation with the facts, I prefer to confine myself to the latter.

PITTSFIELD, MASS. JOHN F. KELLY.

Electric Coat Hooks.

According to a London contemporary, an Englishman has invented a clothes hook which is so connected with a battery and bell that when the coat or hat is removed the bell rings, thus warning the cloak room attendant. We suggest that for completeness sake a combined phonograph and loud speaking telephone might be added to call out the name of the owner, followed by "stop thief," and that a small detective camera might also be set off electrically to photograph the thief; the cloak room attendant might then be dispensed with, and his salary saved.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Electrification of Air.—A Royal Society paper by Lord Kelvin and Mr. Maclean is published with illustrations in the Lond. "Elec. Rev.," July 20. The object of the experiments, which are described in detail, was "to find if a small unchanged portion of air could be electrified sufficiently to show its electrification by ordinary tests and could keep its electrification for any considerable time; and to test whether dust in the air is essential to whatever of electrification might be observed in such circumstances, or is much concerned in it." The apparatus is described and illustrated and curves of results are given; among other things "the curves show that the air does not retain a negative electrification so long as it retains a positive;" they fouhd no appreciable difference in the ease with which the air could be electrified by discharges from a wire connected to the machine, and in the length of time the air retains its electrification. Some deductions are made regarding the electrostatic force of a cubic centimetre of air, and it is concluded that the "natural electrostatic force in the atmosphere, due as it is no doubt to positive electricity in very high regions, must exercise an important pondero-motive force quite comparable in magnitude with that due to difference of temperatures in different positions."

Atmospheric Electricity.—A note in the Lond. "Elec. Rev.," July 20, recommends the study of atmospheric electricity by means of balloons; a number of such tests have been made within recent years; the theory commonly held is that of Peltier, that the earth has a negative charge and is also surrounded by an electrostatic field, the equi-potential surfaces being approximately parallel to the earth's surface, the positive charge increasing with the height; the experiments of Weber, Elster and others apppear to confirm this but a recent paper by Boernstein in the "Ann. Phys. u. Chem." states that there may exist in the atmosphere "masses" of elecricity of positive sign.

Photo-electric Action of Light.—The difficulties of working with ordinary polarized light in studying its photo-electric action disappear if the cathodes are formed of alkaline metals; an application of this is made by Dr. Elster and Mr. Geitel in a paper in the "Phil. Mag." for July and briefly abstracted in the Lond. "Elec. Rev.," July 20; experiments are described with a sensitive cell of the liquid potassium-sodium alloy; and the results are as follows: "The luminous electrical current attains its maximum when the electrical displacement in the luminous ray takes place in the plane of incidence, its minimum when they are at right angles thereto. In the former case the electrical vibrations contain a component normal to the cathode, but not in the second."

MAGNETISM.

Magnetic Rotary Dispersion of Oxygen.—A paper from "Nature," by Dr. Seirtsema is abstracted very briefly in the Lond. "Elec.," July 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Units and Quantities.—"La Lum. Elec.," July 7, contains an interesting article by Prof. Blondel, in which he suggests a complete system of photometric units and quantities. After pointing out that the photometric language and the number of units is insufficient, and stating that photometry has preserved without much change the phraseology which was used in the eighteenth century, he points out the imperfections of the present definitions. He shows that there exist six fundamental quantities (the seventh in the table being really equivalent to one of the others) which one has tried to replace with the aid of one single unit, the candle. He classifies these as shown in the adjoining table, discussing each one in detail. (The translation is suggested by the compiler, but the original French terms are given in parenthesis; a difficulty occurs in that the sixth one is termed, in French, "illumination," while the third one, "éclairement," corresponds to what is universally termed, in English, "illumination;" the compiler therefore suggests the term "quantity of illumination" for the former, in conformity with the similar term for the last one; unless some such distinction is made there would be some difficulty in the way of their adoption in English speaking countries; the compiler is also responsible for the indicated correction of the defining equation of the last quantity.)

Physical Quantities.	Symbol and defining equation.	Dimensions.	Names of practical units.
Luminous intensity (intensité lumineuse)	I	I	Pyr (or bougie-décimale=(1-20 violle)
Luminous flux (flux lumineux)	$\Phi = I\sigma$*	I	Lumen
Illumination (éclairement)	$e = \frac{\Phi}{S}$	$I L^{-2}$	Lux
Intrinsic brightness (éclat intrinsèque)	$i = \frac{I}{S}$	$I L^{-2}$	Pyr per square centimetre
Intrinsic radiation (rayonnement intrinsèque)	$\Phi = \frac{\Phi}{S}$	$I L^{-2}$	Lumen per square centimetre
Quantity of illumination (illumination)	$j = e t$	$I L^{-2} T$	Phot (or lux-second)
Quantity of light	$Q = \Phi t$**	$I T$	Rad (or lumen-second), lumen-hour

* is a solid angle, its dimensions being a number.

** In the original this was $e\, t$, but it appears that it was intended to read $\Phi\, t$.

The luminous intensity is what corresponds to the usual term candle-power; the unit of luminous flux is the flux produced in a solid angle equal to unity from a luminous point whose intensity is one pyr, and for this he proposes the word "lumen;" a source having a mean spherical luminous intensity of n pyrs will then have a total flux of $4 \pi n$ lumens; he discourages the use of the terms bougie metre, metre candle, foot candle, etc., and advocates the name "lux" proposed by Mr. Preece, a flux being defined as the illumination from a uniform source of one pyr of a surface normal to the rays at one metre distance, or as the illumination produced on the surface of one square metre by a uniform flux of one lumen; the product of a certain number of luxes by a surface expressed in square metres will then give a number of lumens; the intrinsic brightness (or perhaps better, specific brightness or specific intensity) has been used in two different ways, the more usual one being in the sense of the quotient of the intensity by the surface of the source, as shown in the defining equation in the table, in which case the practical unit is the intrinsic brightness of a source which has an intensity (candle-power) of one pyr per unit of surface, and therefore equal to one-twentieth of the brightness of the Violle standard; the other sense, which he calls intrinsic radiation (see table), is the ratio of the flux emitted and the surface of emission, as shown in the defining equation in the table, the unit in that case being a radiation of one lumen per unit of surface; both of these have the same physical dimensions; the next term, "quantity of illumination," which the author terms "illumination" in French, is the product of the "éclairement" (illumination in English) e, to which an object is exposed by the duration of the action of this illumination, the unit, lux-second, being that of one lux during one second; this quantity, which is an important one in photography, has been named by the Photographic Congress of Brussels the "phot"; the quantity of light should not be confounded with the flux, as it is the product of the flux by the time during which it lasts and is therefore a lumen-second, for which the name "rad" has been proposed by photographers; this unit can also be defined as the quantity of light received on a surface of one square metre submitted to the illumination of one phot; in practice the unit lumen hour could be used, corresponding to the term ampere hour in place of coulomb, and he suggests that in commerce light should be sold in terms of lumen hours; for a given wave length the quantity of light is proportional to the energy of radiation and it could therefore be measured in terms of the erg, like other forms of energy, but as this unit has no simple relation with the photometric effect, each radiation having a different co-efficient of physiological action, he prefers the system suggested. He then gives a number of examples of the practical applications, among others being a discussion of the application of these units to projectors, showing that thereby all confuson can be avoided. (The article is recommended to those who are interested in this subject.)

Measurement of the Pupil of the Eye.—An abstract of the paper of Mr. Henry, from the French, mentioned in the Digest, is published in the Lond. "Elec.," July 20, and discussed editorially in the same issue; it is pointed out that the sensitiveness of the eye is subject to great alteration caused by the changes in the diameter of the pupil; a low hanging arc lamp without diffusing globes would give a high photometric measurement, but the pupil would become so contracted that the eye would receive less light near the lamp than that which would be indicated by the photometer; methods for measuring the pupil of the eye are given, but it is stated in the editorial that none of them are such that the eye under test can be exposed to the illumination which is to be investigated, and it is suggested that a simple modification of the Robert-Houdin method might be adopted, in which this defect would be absent.

Precision of Electric Measurements.—In an article by Mr. Armagnat in "L'Ind. Elec.," July 10, he gives the following figures as the accuracy with which measurements may be made under the ordinary conditions of practice in a laboratory. The absolute ohm is known to 0.1 per cent., the ampere, the volt and the coulomb are known to the same degree of precision; the absolute value of the capacity of a good condenser of mica can be given to 0.2 to 0.3 per cent.; standard mercury ohms may be made to an accuracy of 0.001 per cent. and standards made of solid metal to 0.01 per cent.; resistance boxes are adjusted to a higher

precision than 0.05 per cent., but Wheatstone bridge measurements made with them rarely exceed a precision of 0.2 per cent.; currents can be measured to within 0.01 per cent. with the electro-dynamometer and the Thompson balance, but with tangent galvanometers it is impossible to attain 0.5 per cent. with a single observation; the electrolytic processes admit of a precision of 0.05 per cent; the errors in the use of the Clark cell are about 0.2 to 0.3 per cent.; ampere-hour meters rarely read closer than 1 per cent. and more often 2 to 3 per cent.; with a very constant current watts can be measured with an error equal to the sum of the errors of the amperemeter and the voltmeter; with a wattmeter the errors easily reach 1 to 2 per cent.; with good instruments and after making all corrections a better result than 1 per cent. cannot be guaranteed; the capacity of a good mica condenser can be measured to 0.05 per cent., ordinary condensers differing from 1 to 2 per cent. between two measurements; the co-efficient of self-induction of a coil without iron can be measured to 0.2 to 0.3 per cent., but with iron errors of 3 to 4 per cent. are easily committed.

Silk as a Dielectric for Condensers.—The Lond. "Elec.," July 13, abstracts from the Italian a paper by Mr. Lombardi, describing some completely successful experiments; the chief difficulty was in the humidity of the silk; with 100 rectangular sheets of tinfoil, 28 cm. by 18 cm. separated by double sheets of carefully dried silk (single sheets being subject to short circuiting), with a total thickness of 1.2 cm. a capacity of 0.351 microfarad at 21° was obtained, with an insulation resistance of 10,000 megohms; the sum of the residual discharges after one minute was a little over 3 per cent.; the measurements were repeated after seven months and gave slightly higher results; the temperature co-efficient of the specific inductive capacity was about one-thousandth per degree centigrade, positive for rising temperatures. Silk condensers may be safely used for all differences of potential commonly in use; with 500 volts from a battery a spark passed across the silk.

Measurements of Coefficients of Self-Induction.—The "Journal Télégraphique," June 25, contains a short article by Dr. Tobler, in which he describes a simple, practical method which is easy to apply and requires only cheap apparatus, the accuracy being from 1 to 2 per cent.; it is based on the method of Maxwell as modified by Vaschy la Touanne, Pirani and others.

Lightning Rod Testing Apparatus.—London "Electricity," June 22, describes and illustrates an apparatus made by Siemens Bros. & Co., consisting of a magneto-inductor and bridge.

Magnetic Curve Tracer.—The original of the article mentioned in the Digest last week is published in "La Lum. Elec.," July 14.

DYNAMOS AND MOTORS.

Sine Current Alternators.—The Lond. "Elec.," July 20, in discussing a recent editorial in The Electrical World, claims that notwithstanding the conclusions passed on the deductions of Kennelly and Duncan, they are by no means inclined to agree that there are sufficient grounds for the conclusions arrived at in the editorial; theoretical considerations are apt to ignore those influences, which, though difficult to put into exact mathematical form, are just the things which determine the truth or fallacy of the conclusions; referring to Dr. Duncan's researches it is claimed that the results were not compared with those which might have been obtained from any other alternator; it is asked whether there is anything to show that the motor was more efficient than it would have been in any other case.

Application of Small Motors.—A paper by Messrs. D. T. & A. C. Heap is reprinted and discussed editorially in the Lond. "Elec.," July 20. A diagram is given showing the switch arrangement adopted by the St. Pancras Vestry to induce customers to use motor power. A number of tables are given containing the results of tests of some existing plants, including the efficiency and the cost of the power under different conditions; among these are a Crompton compounded motor driving capstan, a Thomson-Houston shunt-wound motor of 15 h. p. for driving saws and planing machines, a Crompton series-wound motor for driving a hoist, another for driving chaff cutters, another for a meat chopping machine, and another for rivetting and drilling.

Dynamos Without Iron.—In an article by Prof. Pietzker, in the "Elek. Echo," June 16, he describes the principle and gives the theory of a dynamo without iron; it consists essentially of two drum wound armatures, one inside the other, revolving in opposite directions, or one revolving and the other stationary; each is provided with a commutator and brushes in the usual manner; there is no separate field; the brush lines make an angle of 90 degrees with each other; to start the machine a current is sent through the machine, after which the machine will excite itself; the two armatures may be connected in series or in multiple. In a small model, in which one was fixed and the other revolving at 3,000 revolutions, the current was one-eighth of that required at starting.

TRANSFORMERS.

Transformer Systems.—London "Lightning," June 21, contains an article by Mr. Sparks on alternating current transformers, in which he discusses the various systems and the importance of a number of factors in such systems and transformers. The Lond. "Elec. Rev.," July 20, contains another communication from Mr. Whitcher, giving, however, nothing of particular interest.

ARC AND INCANDESCENT LIGHTS.

Lighting.—In "L'Ind. Elec.," Mr. Hospitalier mentions some abstracts from a recent work by Mr. Marechal on the lighting of Paris, which he recommends very highly and which he says ought to be in the hands of every one who has to deal with lighting. He deduces the formula that the height of a lamp should be equal to 0.707 times the distance between the lamps, which will give a maximum light at the intermediate points; this formula always gives too great results for practice and therefore shows that lights are always placed too low to satisfy the conditions for the best illumination. He describes the following method for calculating the illumination on a point of a horizontal plane as P in Fig. 1 when the light is at L and the curves giving the intensities at different angles are

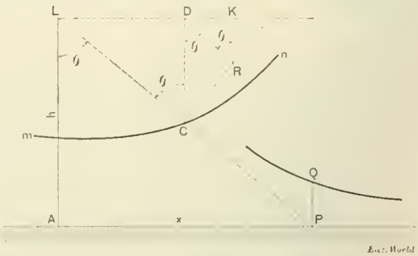


Fig. 1.—Curves of Illumination.

represented by the line MN. From the point P draw the line LP, then CD, then DR, CR, perpendicular to LP and finally KR, then the illumination at P will be equal to the distance KR divided by the square of the height h of the lamp above the plane; by choosing the scale of the diagram so that the square of h is equal to unity, the distance KR will give the illumination directly in metre-candles; by this simple graphical method the illumination may be found for any point, and the resulting curve of illumination Q drawn. He applies this method to showing what the photometric curve mn of a light should be, which when placed at a certain height gives a uniform illumination for a horizontal plane; this gives the conditions which should be fulfilled by burners, reflectors, globes, diffusers, etc.; the photometric curve with such apparatus should be as close as possible to that theoretical form; such curves are shown in broken lines in Fig. 2, 1 being for a uniform illumination of one

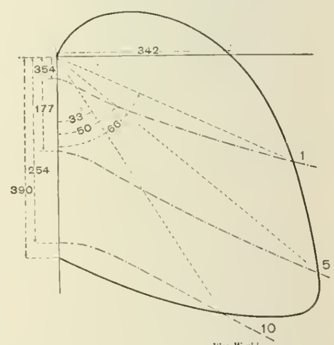


Fig. 2.—Photometric Curves.

metre-candle on a horizontal plane at a height of 5.95 metres, curves 5 and 10 being for 5 and 10 metre-candles respectively; the full curve is that for an arc lamp with an opal globe. The illumination of surfaces such as a street may thus be readily calculated from the photometric curve of a source, the distance between the lamps and their heights; such illumination can be indicated by curves of equal illumination analogous to the contour lines of a topographical map. In conclusion he shows how the prices of illuminations produced under different conditions should be determined and compared; lighting depends on the duration, the surface and the illumination, for which quantities he uses the units hour, "are" (the French unit of surface, equal to 100 square metres) and the candle at one metre; the price of the lighting is then the sum paid divided by the lighting thus determined. Figures obtained in this way for a number of streets in Paris are given in a table and are as follows for the above named units and the centime as the money unit: with ordinary gas burners using 140 litres per hour, the price is 6.81; for regenerative gas burners requiring 750 litres per hour it is 3.65, while for 10 ampere arc lamps as used on a number of the boulevards, the average is 1.58, showing that the latter streets in which the arc light is used are lighted more economically.

Interior Lighting.—In a short note in "La Nature," June 16, it is stated that it is usual in computing the lighting of a large hall to make the number of candle power equal to one-half or one-third of the volume of the whole room expressed in cubic metres; it is thought that the former figure gives rather high results and the latter somewhat low, a

mean of the two being suggested as preferable; attention is also called to the fact that the effect depends very greatly on the furnishings of the room, the color of the walls, etc. Many engineers determine the lighting from the floor space, counting on between 2 and 4 candles per square metre, but this figure is often exceeded where the illumination is to be brilliant; it is stated that in a number of auditoriums in Paris the lighting varies between 6 and 30 candles per square metre of floor space, the former for a good illumination and the latter for a very brilliant one.

Incandescent Lamps.—Mr. Larnaude's paper (see Digest, July 28) is translated in abstract in an editorial in the Lond. "Elec. Rev.," July 20, but including apparently no editorial comments.

Coloring Lamp Bulbs.—In the serial in the "Elek. Anz.," July 12, on the manufacture of incandescent lamps, methods are described for frosting and coloring bulbs.

The Davy Arc Lamp.—This lamp, for which great compactness is claimed, is illustrated in the Lond. "Elec.," July 20.

TRANSMISSION OF POWER.

Series Transmission.—An article by Mr. Schulz, in the "Elek. Echo," June 23, describes an installation in which 15 h. p. was transmitted from a compound wound generator to a shunt wound motor, the system being a complete failure, owing to the use of an old steam engine whose speed varied very erratically; at certain times the motor would even reverse in direction; the motor and generator were then replaced by others containing series windings, after which the installation worked very satisfactorily notwithstanding the irregular action of the steam engine.

ELECTRIC RAILWAYS.

Railways in Germany.—The Lond. "Elec. Eng.," July 20, takes from the Foreign Abstracts of the Institution of Civil Engineers an abstract from a German engineering journal, comparing the cost of horse traction with electric traction in Germany; the figures are chiefly of local interest.

Electric Railways in the United States and Canada.—A paper by Mr. Wilkinson on this subject is begun in the Lond. "Elec. Eng.," July 20.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Gas vs. Steam for Central Stations.—Several correspondents to the London "Elec. Eng.," July 20, discuss the recent article in that journal on that subject (see Digest July 28 and August 4) and point out important errors and corrections, giving also other figures which are thought to be more correct; the correspondents argue in favor of gas and all conclude that if the figures are corrected the results will be in favor of gas, both in first cost and in working.

Alternating Current Station at Cologne.—London "Lightning," June 14, publishes a review of Mr. Coerper's book by Mr. Gisbert Kapp. Mr. Kapp calls attention to a clock in this station which is driven by a small synchronous current motor, the clock being therefore at any instant a correct measure of the engine speed; similar clocks are connected to the distributing mains at consumers' houses and must run synchronously with the clock in the engine room; the speed of the engines is governed so accurately that the clocks keep correct time; "that such a system of time distribution should at all be practically possible, is a proof of the exteme accuracy with which the engines are governed."

WIRES, WIRING AND CONDUITS.

Wiring Chart.—A double page chart by Mr. Sanders is published as a supplement to the Lond. "Elec.," July 20; by means of it most of the calculations which have to be made in wiring are made either by a system of co-ordinates and straight line curves, or by the direct comparison of a number of parallel scales and columns; the chart is based on current density as one of the chief elements; the use of the chart seems to be quite simple.

Short Circuits Caused by Lightning.—A correspondent to the Lond. "Elec.," July 20, states that Hertzian waves might start an arc between neighboring conductors during a thunderstorm, treating the matter as a serious danger; in an editorial it is stated that no instance of any arcing has occurred in ordinary house wiring and not a single fire has been recorded in England during a thunderstorm that could be attributed to electrostatic effect in electric lighting conductors.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Multiple Telephony.—The "Elek. Echo," June 30, contains a full description, accompanied by a large and quite complete diagram of connections, of the Nissl system, described briefly in the Digest June 2, in which any subscriber can connect himself with the station independently of the others.

Burglar Alarm.—A system is described and illustrated in the "Elek. Echo," June 30, in which threads stretched across windows, doors or passages, on being touched, removed a small insulating wedge from between two metallic springs, which on making contact with each other ring the alarm.

Time Distribution.—See abstract under "Alternating Current Station at Cologne."

ELECTRO-CHEMISTRY.

Electrolysis of Alkaline Chlorides.—Mr. FitzGerald, in a communication to the Lond. "Elec. Rev.," July 20, states that the E. M. F. is perhaps the main element which determines the cost of commercial electrolysis; he states that there are but three materials at present available for the anode in the electrolysis of alkaline chlorides, namely platinum, gas carbon and lithanode. He quotes from a paper published a year ago in which he states that no evolution of hydrogen within the tanks should be allowed; it may readily be absorbed in the reduction of a metallic oxide economically regenerated by heating in air; no gaseous chlorine should be liberated; when, in the electrolysis of sodium chloride, both hydrogen and chlorine are liberated, 2.30 volts will be required, but when the hydrogen is absorbed only 1.61 volts will be required, while, when both the hydrogen and the chlorine are absorbed, 1.09 volts will be required. He enumerates certain conclusions to which he has come, among which may be mentioned that alkali and bleach must both be obtained, their simultaneous production being an economical necessity; that the alkali and the hypochlorate (bleach) must not be traversed by the current; he thinks that the conclusions can be realized in a practical form. (Mr. FitzGerald is the inventor of "lithanode," which is peroxide of lead in plates, and although not so stated, it is not unlikely that he refers to the application of this material.)

MISCELLANEOUS.

Chromium.—According to the Lond. "Elec. Eng.," July 20, Mr. Moissan has succeeded for the first time in obtaining chromium in a pure state in his electrical furnace; a sample of 40 lbs. of this rare metal was exhibited at a recent meeting of the French Academy of Sciences; he purifies it in the presence of a double oxide of calcium and chromium.

The Giffard Prize.—According to the Lond. "Elec.," July 20, the subject of the prize for 1896 will be "the transmission of power by electricity in various applications, machine tools, railways, tramways, bridges, ships, docks, etc. Those competing must commence the essay by a summary of the present condition of the subject, and give the details of some scheme which has been executed, or the draft of a suggested scheme."

World's Fair Awards.

Though the full report of the World's Fair Judges on insulated electric wires is not yet in the hands of the Awards Commission, the awards have been made public, and we are also enabled to print an account of the tests to which the various wires examined were submitted. The judges in this department were Professors D. C. Jackson, B. F. Thomas, R. B. Owens and M. O'Dea, and the tests ordered by the Awards Commission were as follows:

First, a breakdown test under high pressure to the point of rupture of the insulation, using a 2,000-volt Westinghouse alternating current.

Second, a soak test extending over a period of sufficient length to exhaust all but the best wire, which proved to be 100 days, the test ending to April 1, 1894. There were five solutions used, as follows: a, 10 per cent. sulphuric acid solution; b, 10 per cent. ammonia solution; c, a saturated lime water solution with heavy sediment of lime; d, a solution of subway refuse or scrapings from Chicago subways suspended in Chicago river water; e, Chicago hydrant water. The wire used was No. 14 B. & S. with $\frac{3}{32}$-inch insulation. There were ten varieties of commercial wire subjected to this test; two samples 100 feet long of each were used and tested at least once a week for resistance and the figures kept for computing the final results.

To these tests Prof. Jackson added a third, with the consent of the committee, which consisted of a combination breakdown and soak test. Five solutions made up as those in the second set of tests, were used, the wires being connected up in short lengths to a 6,000-volt current and kept in circuit until the insulation was ruptured.

Prof. Jackson and the other members of the committee are now preparing an exhaustive report on their work, but the results have been given out in advance, along with awards to the successful competitors. The first award is to W. R. Brixey for "Highest excellence in insulating qualities, durability of insulation under conditions found in commercial service, and uniform high excellence in mechanical qualities of insulation." Other awards were to the Okonite Company, New York Insulated Wire Company, Simplex Electric Company, Standard Underground Cable Company, and Norwich Insulated Wire Company. J. A. Roebling's Sons' Company received awards for bare copper and trolley wire and the Washburn & Moen Company for bare copper wire.

Government Test of Wire Cables.

Lieut-Commander Duncan Kennedy, of the U. S. Navy, a distinguished electrical authority, has written a report on his method of testing cables as applied to a specimen of double conductor cable manufactured by the National India Rubber Company, of Bristol, Conn., which most successfully withstood the test applied. After one month's immersion in salt water the cable was tested for insulation and found to have a resistance of 2,270 megohms per knot. It was then further tested by cutting off about ten feet and after putting knots and kinks in it and twisting up tight, a 300 pound weight was attached to the end. In one kink the outside braiding was torn, but it was impossible to tear it again though it was particularly tried. After this handling the same piece was put in a barrel of water and tested for continuity and leaks. No injury seemed to have been done to the wires or insulation. The copper wires were found to be tough and pliable and the tinning well done,

Mather Multipolar Generator.

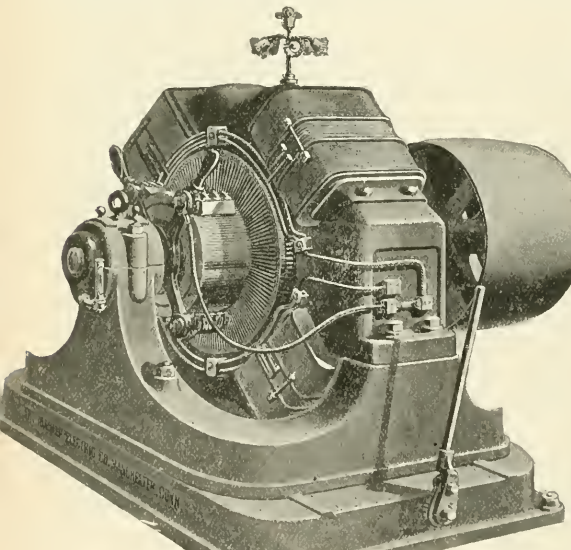
The generator we illustrate combines the results of the wide experience in the design of electrical machinery of the well-known Mather Electric Company, Manchester, Conn.—one of the pioneers in the electrical field. Embodying the most advanced ideas in design and construction, the claim that a corresponding increase in efficiency, durability and regulation under extreme loads has been attained with the new generator is one that rests upon a good foundation. It will be noted that the machines resemble in some respects the Thury type.

A point in the design of these generators of notable mechanical advantage is that the fields are cast in four pieces and entirely separate from the frame; these are bolted together, so that the time required for taking apart a machine to remove the armature and for reassembling is reduced to a minimum, and the work accomplished with the greatest of ease. The machines are designed to be belt-driven or direct connected to the shaft of the engine, and being reversible on their bed plates can be run in either direction at will by making a slight change in the connections. They are self-oiling, self-exciting, self-regulating, and, after being started require no attendance. The fields are compound wound and consequently the machines are entirely self-regulating, and equally well adapted for electric lighting, electric railway or power purposes. They are built in sizes from 30 kw. to 220 kw. capacity.

The railway generators are wound for a nominal voltage of 500, but, having a rheostat in the field circuit, the potential can be raised to 600 volts without undue heating, and even 50 per cent. overloads will be borne for short periods without injury to the machine.

The common difficulty with generators of sparking at the brushes, usually caused by the points of commutation shifting with variations in the load, has been entirely overcome; after the brushes have once been adjusted, further change is not necessary, no matter how sudden may be the variations in current. There is no sparking even with currents in excess of the rated capacity of the machine, and it is impossible to distinguish by watching the brushes whether the generator is loaded or not. The machines can be operated indefinitely at full capacity without any undue or dangerous heating anywhere.

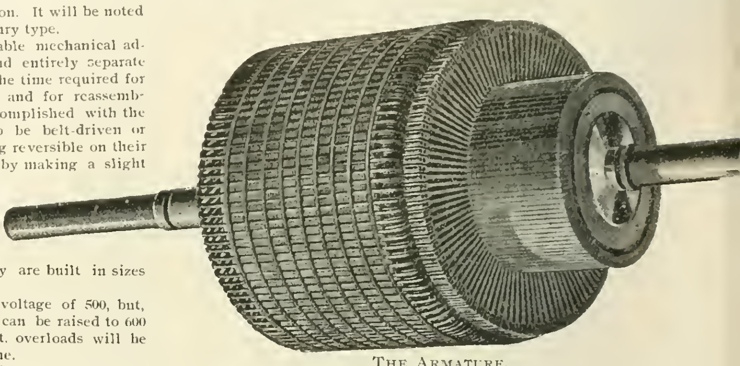
The bearings are self oiling, a large reservoir below each journal holding a quantity of oil, which is carried up on to the bearings by oil rings



Improved Multipolar Generator.

revolving upon the shaft. No attention to the bearings beyond a periodical examination and renewal of oil is required. Automatic alignment is secured by the use of ball bearings, which adjust themselves and can never bind on the shaft. The supports for the bearings and the entire bed plate are cast in one piece, a construction which gives great strength and rigidity to the bearings, and secures the greatest possible freedom from vibration. There are four sets of brushes, and each brush is held in an independent holder; hence any single brush can be raised from the commutator without disturbing the others, and, each having its own spring, may be perfectly adjusted. The diametrically opposite brushes are of the same polarity and are connected. The rocker arm of the brush holder is of rigid construction and the different parts are perfectly insulated; it is designed so that it will adjust all the brushes simultaneously.

The armature, which we illustrate, has a core built up with thin discs of soft iron which are forced together under pressure and rigidly keyed to the shaft. All washers are first treated to an improved annealing process peculiar to the Mather Company, with the result that the armatures when revolving in the most intense magnetic field will only heat up to a few degrees above the surrounding temperature. The greatest care is



The Armature.

taken in the insulation of these armatures. Before winding, there is fitted into each slot a carefully made duct of the best mica, through which the wire is wound. The simplicity of the winding is particularly noticeable at the end of the armature, where the wires, instead of being overlapped and bunched together, stand out from the core and from each other, thus allowing free circulation of air around every conductor. No wires having a large difference of potential are adjacent to one another. The necessary voltage is secured by revolving a comparatively small number of coils of wire in a powerful magnetic field, rather than by using a large number of coils and a weak field, as is the usual practice. The small amount of wire on these armatures accounts, in great measure, for the absence of sparking at the brushes, and the fixed position for the points of commutation under variations of load. No matter how great the current in the armature conductors, the field is always powerful enough to overcome the effect of their cross induction, and consequently the lead does not have to be changed.

The field consists of four steel castings rigidly bolted together and to the cast iron bed plate. The exciting coils are compound wound on metal bobbins, which can be readily slipped on or off by loosening a few bolts and raising one of the field castings. The fields are so compounded that as the current increases, the voltage rises sufficiently to make up for the loss of drop or for variation in speed. The employment of cast steel in the fields increases the efficiency of the machine much over what it would be if of cast or wrought iron construction.

The commutator, as will be noted, is of massive and substantial construction. The best drop forged pure lake copper bars are used, which, though more costly than cast bars, are preferable on account of their greater density, longer life and absence of blow holes or black spots in the metal. Great care is taken in the insulation, the very best mica being used throughout. By a peculiar construction it is an impossibility for any bar to work loose while the commutator is on the shaft.

Hydraulic Press for Covering Insulated Cables with Lead.

One of the most interesting inventions brought out by the development of electricity is the process of encasing cables, with lead, for the purpose of protecting them from mechanical injury, and also to exclude moisture, when laid underground, or used for submarine service.

The accompanying illustration shows a lead press recently patented by Mr. H. B. Cobb, general manager of the Chicago Electric Wire Company, Wilmington, Del., which embodies some unusual features and for which important claims are made. Hydraulic presses for covering cables with lead are quite old, the first being used in England something over fifty years ago, but not until now has it been possible to construct a machine that would satisfactorily cover a cable with lead of any desired uniform thickness or size, or with speed sufficient to be economical.

Ordinarily enormous power is required to form a lead pipe, and herein the greatest difficulty presented itself to the successful machine, for the reason that the capacity was limited to the strength of the metal employed in its construction. Other defects also very materially retarded and reduced the capacity of the machine, such as the time wasted in heating the dies and blocks preparatory to starting the press and the long stops between charges to allow the lead to cool sufficiently to form the pipe. The changing of dies from one size to another was also a tedious and expensive operation.

The press herein illustrated entirely overcomes all of the serious objections mentioned, as will appear from the following description:

In covering cables with lead it is desirable and necessary to pass the

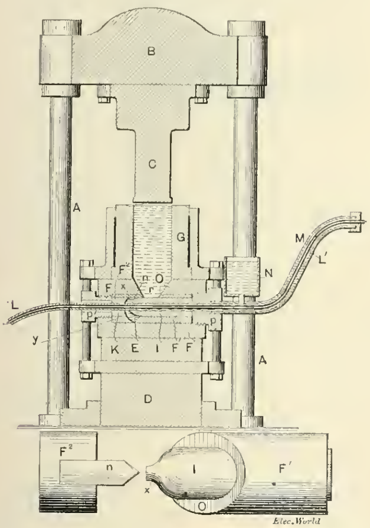
cable to be covered through the press horizontally or at right angles to the press, in order that the cable can be more readily handled. To do this great difficulty was experienced owing to the downward pressure of the lead against the dies which had the effect of throwing the dies out of centre or crushing them. To overcome this a bridge was interposed between the dies and lead cylinder. While this in a measure overcame the difficulty and protected the dies, yet the bridge obstructed the passage of the lead to the dies which rendered it necessary to have great heat and enormous pressure to form the pipe, making the process slow and expensive.

It will be noticed, owing to the peculiar formation of the die block, F, as shown, that the bridge above mentioned is entirely dispensed with and that the lead is unobstructed and free in its passage from the lead cylinder, G, to the dies I, K, having the effect of greatly reducing the power necessary to produce a lead pipe.

The reduction in the amount of power required made it possible to form the pipe from lead very nearly cold, in fact the only object in heating the lead at all is the convenience in handling it. The lead is introduced into the lead cylinder G in a molten state, but is at once cooled by cold water circulating around the cylinder and dies, reducing the temperature to less than 100 degrees or very near cold. When the pipe is formed the rapidity of cooling the lead avoids the usual long stops between charges of from two to five minutes to allow the lead to set sufficiently to form the pipe, the press starting the moment the cylinder is filled with the molten lead without regard to the size of the cylinder or the amount of lead it contains.

One of the great advantages in reducing the time between charges and running the lead so cold is to avoid any possibility of injury to the cable by excessive heat while standing still in the press.

Preparatory to starting a press to cover cables, it has been the practice and was necessary, owing to the amount of heat required, to heat the dies in the air block, C, to about 300 or 350 degrees by means of six or



Hydraulic Press for Covering Insulated Cables with Lead.

eight Bunsen gas burners, the time required to heat the same being from one to three hours according to the size of the block to be heated.

In the Cobb press invented the gas burners are entirely dispensed with and at no time does it require over fifteen minutes' time to start from a cold press.

The changing of dies from one size to another, often necessary, could only be accomplished in presses now in general use under the greatest difficulty and expense. A mild estimate of the time and labor required would be four men and one half day's time, while in the press illustrated the same work can be performed with two men in less than one-half hour.

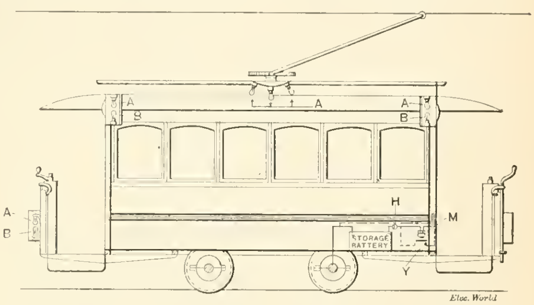
The press works with remarkable rapidity. In a recent case of a government contract for 200 miles of wire, $\frac{5}{16}''$ outside diameter, the wire was encased with a $\frac{1}{64}''$ covering at the rate of 50,000 feet per day. In another instance over 11,000 feet of No. 14 B. & S. wire was lead covered in an hour.

The great capacity of this machine, together with the precision with which it performs its work, has opened up a new field in electric wire covering. It has always been desirable to place upon the insulation of an electric wire a covering both water and fireproof. Various inventions in the line such as tape or braid saturated with a fireproof solution have been made. To cover the wire with a sheathing of lead has been known to accomplish the object, but the difficulty has been in finding a press that could make a lead pipe sufficiently thin, or rapidly enough to be able to compete with taped or braided wires. This difficulty has apparently been overcome by the invention of Mr. Cobb, and his company has entered the field with a wire encased in lead $\frac{11}{64}''$ thick in competition with taped and braided wires.

The range of work which this machine can produce is as great as the rapidity of its action. Perhaps the smallest lead pipe ever manufactured was made on this press, the outside diameter being but $\frac{1}{16}''$ while the diameter of the bore would just admit the insertion of a human hair or about $\frac{4}{1000}$. While this is the minimum size of pipe the machine can produce, the maximum size is about $2\frac{1}{2}''$ inside diameter, with the walls $\frac{1}{4}''$ thick, which gives the press a scope sufficient to encase with lead the smallest and largest wire manufactured.

Electric Car Lighting System.

Upon the invitation of Mr. W. M. Miner, the electrical engineer of the American Manufacturing and Engineering Company, 143 Liberty street, New York, a number of gentlemen were given an exhibition on August 1 of a new electric street car lighting system as installed in a car at Hoboken, N. J. The visitors were taken aboard a car at the foot of the Fourteenth street ferry, Hoboken, and in running over the road the trolley circuit was frequently broken in order to show the value of this system in always keeping the car illuminated whether the trolley is on or off. The experts present expressed great satisfaction with the working of the system, no hitch whatever having occurred, notwithstanding the severe tests applied.



Electric Car Lighting System.

The system consists in the employment of a small storage battery of six Donaldson-Macrae storage cells, which are used to light a duplicate set of lamps should the trolley come off, or the motor current gives out or be interrupted in any way, the battery being switched on automatically when the motor circuit is broken. Referring to the illustration, a trolley current passes through the electromagnet M, which completes a circuit through incandescent lamps connected in series in the usual manner. The same current also passes through the storage battery, keeping it charged.

If the trolley comes off, the current gives out or is interrupted in any way, the armature of the magnet M is drawn back against its backstop, Y, closing the supplemental circuit from the storage battery through the switch H to the armature of the magnet M, backstop Y, and lamps B, B, returning to the storage battery, thereby insuring light in the car whenever lights are required independent of the action of the trolley.

When the main circuit is restored by replacing the trolley or otherwise, the current takes its original course through the main circuit lamps, energizing the magnet M (drawing its armature away from the backstop Y), storage battery and ground, recharging the storage battery and lighting the car as before, thus automatically and positively insuring a constant light in the car under all circumstances. The extinguishing of lights in a public conveyance is so exceedingly annoying, particularly to ladies or timid persons, that this simple system of always assuring light in a car will doubtless meet with a wide appreciation.

A Large Electric Railway Plant.

The tendency for very large electric direct coupled generators, especially for railway power plants, has been illustrated again in a contract just closed between the West Chicago Street Railway Company and the Siemens & Halske Electric Company of America, for three 2,000 h. p. and one 1,000 h. p. generators.

A recent issue of the "Chicago Tribune" says: "The station is to be located on the property of the street railway company on Washington boulevard and Western avenue, a central location in the territory which is to be served. The station which will be constructed there is intended to ultimately accommodate five 2,000 h. p. generators and one 1,000 h. p., a total capacity of 11,000 h. p., which will make it the second largest in the country, and render it capable of moving 500 cars.

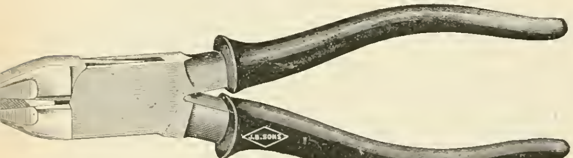
"Work is to begin on Van Buren street immediately. The line will have to be entirely rebuilt. About three miles of street will be converted

into electric line, the cars being taken at Halsted street and connected with the cable. The motor cars will be connected to the cable so there will be no delay. Mr. Chapman has devised a scheme for disconnecting the machinery in the motor car while the train is being drawn by the cable. The bids foi the electric machinery calls for the completion of the first dynamo within four months of the award of the contract. The contract calls for the completion of an additional machine every fifteen days. The contract for the engines will be let immediately. The West Side power system is ultimately intended to operate electric lines on sixty miles of street, and the West Side company contemplates converting 120 miles of horse car lines into electric lines.

"The contracts for the construction of the North Side power house and for the engines and machinery were let recently. The power house will be located on the river opposite Sharpshooters' Park at California avenue and Roscoe boulevard. The station will ultimately have a capacity of 6,000 h. p. At present it is the intention only to operate 135 cars from that station, and the contracts which were let called for generators aggregating 2,800 h. p. Contracts for the engines were let to the Fiaser-Chalmers Company, and for the electrical machinery to the Siemens & Halske Electric Company of America. The generators at the North Side station aie intended to operate both North and West Side lines. The territory which will be covered will embrace all the lines of the North Chicago Street Railroad Company and will also furnish power for all the West Side lines north of North avenue. Power will also be furnished for a new line which is to be constructed on Elston avenue, from Chicago avenue northwest. This Elston avenue line is being built by the Chicago Electric Transit Company, a corporation that obtained an ordinance some two years ago. At present there is supposed to be no direct connection between that company and either the North Side or West Side companies, but it is intimated that ultimately the West Side Company will absorb that property. The entire electrical plants of the two street railroad companies embrace double tracks on 100 miles of street. It is expected that the first electric cars will be in operation early next year, and others will be rapidly equipped after that. The cross-town lines can be made ready to operate by electricity rapidly, for they will not have to be rebuilt. All lines laid within the last year or two were put down with the intention of changing them from horse to electric, and nothing will be necessary but to string the trolley wires."

Insulated Pliers.

We illustrate herewith a form of pliers designed for the use of trolley men and others who are obliged to handle electric wires. The handles are covered with hard rubber for insulation. The advantage which the pliers have over a rubber glove is that the latter is apt to slip and also becomes soft and porous with age and therefore useless as an insulator. The rubber used upon these pliers will neither become soft nor slip off



Insulated Pliers,

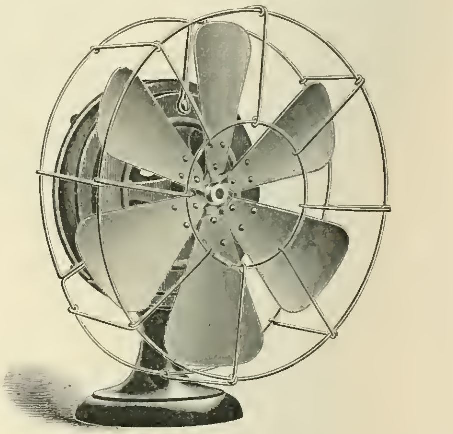
like a glove, nor will it break off; in fact it requires a hammer and chisel to remove it, and the rubber will stand boiling for five hours before it becomes soft. In view of these advantages over the rubber glove, its value is obvious to the electrician, who with it can handle any live wire with perfect safety. These pliers are made by Jacob Brombacher's Sons, 30 Cliff street, New York, under the name of "The Perfection Hard Rubber Insulated Pliers."

A Large Alternator.

At the works of the Fort Wayne Electric Corporation there is now running and being tested a new alternating current dynamo, the last of a series of iron clad alternators designed by Mr. James J. Wood, the company's electrician. This alternator, it is claimed, has the largest capacity of any single armature, compound wound, alternator constructed in this country, having one-fifth larger capacity than the big alternators exhibited at the Chicago Exhibition. The machine from the first has worked beautifully, and in every particular has more than met the expectation of the designer, and, so far as the workmanship is concerned, which is of the highest possible character, it reflects great credit upon the ability of the workmen who constructed it. The design is an artistic one, embodying all the beautiful lines and curves exhibited in all of Mr. Wood's apparatus, while the efficiency is considerably over 90 per cent. Judging from the operation of this alternator during the test, the company predicts a great future for it, believing that no person could see it work without being favorably impressed by its operation. It is capable of operating 6,000 16 candle-power lights and some idea of its size will be realized from the following statement of its dimensions: It is 16 feet long, 8 feet wide and 10 feet high, and weighs 31,000 pounds, producing a current of 150 amperes at 2,200 volts, and requiring an engine of 600 h. p. to drive it.

Alternating Current Fan Motors.

The General Electric Company has just perfected a fan motor for use on alternating current circuits. It is small and compact, and is constructed for any alternating current circuit of 52 or 104 volts. The armature or moving part is nothing more than a solid metal wheel hung on one bearing. It has no wires at all, no brushes, no commutators, no collecting rings, in fact no contact parts at all to cause trouble. The current from the transformer enters only a number of stationary field spools, which cannot burn out and which are entirely enclosed and pro-

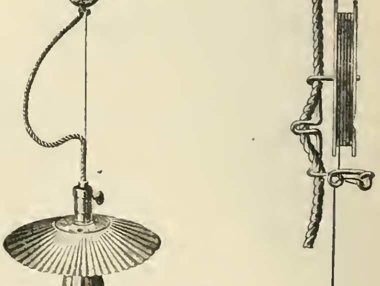


Alternating Current Fan Motor.

tected. The fan is ten inches in diameter, has six blades and is protected by a polished brass guard. It starts as soon as the current is thrown on and runs at 1,800 revolutions, giving quite a powerful and cooling breeze. The height of the motor and fan over all is only twelve inches. The principal feature of this fan motor, contra-distinguishing it from all other fan motors, is that it is impossible for it to get out of order. It is finished in black japan on a broad stable base.

Cutter's Cord Adjuster.

In spite of the variety of automatic cord adjusters now on the market, the number in use is quite small, most of them being expensive and rather bulky, some fully as large as the lamps and shades whose height they adjust, so there is much to be desired on the score of neatness. What is more, it requires some skill and the use of tools to put them in place, and with most forms the drop cord has to be disconnected from



Cord Adjuster.

the socket before the adjusting device can be put on. The device really needed, as shown by a growing demand for such an article, has been one which would be small and neat enough to be quite sightly and which could be quickly slipped on to the drop cord without the use of any tools. Such a form is now offered by Mr. George Cutter, of Chicago, its action being apparent from our illustration. It will take up about three feet of slack in the cord (which is enough to meet all ordinary requirements) and holds the lamp securely in any position. The device is nickeled and neat in appearance.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, August 4, 1894.

THE ELECTRICAL STOCK MARKET is suffering somewhat from the lethargy cast on the market in general by heavy shipments of gold and the excessive hot weather, which is not conducive to activity in stocks. Though the market has been dull prices have held firm and in most instances scored slight advances.

WESTINGHOUSE ELECTRIC business reports are of an encouraging nature this week. The United Electric Light & Power Company, which, as stated in these columns, is to use eight of the Westinghouse World's Fair generators for electric lighting in New York City, has been reorganized without floating debt, and with ample capital for additional plant. In the reorganization plan it is said the Westinghouse Company has received bonds with a bonus of stock for its bills and accounts receivable against the United Company. The Westinghouse Company will receive its pay for the World's Fair apparatus in bonds and stocks on the same basis as cash subscribers. In this way the company will have in its possession bonds and stock to the amount of nearly $1,000,000. G. W. Hebard, second vice-president of the Westinghouse Electric Company, has been made president of the United Company. The reports from the Westinghouse Works show the same tireless energy on the part of the executive officials and in the efforts made to increase facilities in order to meet the increasing demand for Westinghouse apparatus. The price for lamps has recently been established at 25 cents for 16 candle power, with discounts as high as 20 per cent. The company has effected a deal with the Brush Electric Company, at Baltimore, whose station was burned. Former Brush preferred stockholders took 5 per cent. mortgage bonds and the Westinghouse Company received nearly all the common stock. The Westinghouse has sold the Brush people four generators of the same size as the World's Fair apparatus. Westinghouse common stock holds firm around 35 and there is now a bullish sentiment towards it.

GENERAL ELECTRIC has rather dropped out of sight as a security traded in either for speculation or investment. Sugar and a few railroads have monopolized the exchange market and General Electric has had an unusually dull week. It has scored ⅜ of a rise over last week's figures but it is due mainly to manipulation. Reports of heavy manufacturing by this company still continue, and Wall street is every day looking more favorably upon the stock. While the company's present claim of $1,000,000 gross business a month is not as much as what it has done heretofore, it shows the company is holding the lion's share of the electric business and with prospects of once more attaining its former position.

THE INTERIOR CONDUIT & INSULATION COMPANY paid its 5 per cent. scrip dividend on August 1. This company has done a splendid business in fan motors this summer, and while the season is about over for this class of motor, the conduit people have large orders for their heavier machines. Stock quotations have not been lowered by the payment of a scrip instead of a cash dividend, and this security is held around 55.

THE EDISON ELECTRIC ILLUMINATING COMPANY of New York, paid its regular 1½ per cent. dividend August 1. This stock continues to range around par and is bought and sold very little at present.

THE EDISON ELECTRIC ILLUMINATING COMPANY of Boston, paid a 1½ per cent dividend August 1. Though this is the same rate of dividend paid as the New York Illuminating, the Boston stock is held firm around 120 and quotations have not changed for months.

WESTERN UNION TELEGRAPH has been comparatively active and scored a fraction of a rise for the week.

BELL TELEPHONE also gained a fraction over last week's quotations, but there have been no moves of the company that would have any bearing on quotations. Trading in the stock was very light.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	96	98
* " " " Brooklyn	100	101	103
* " " " Boston	100	117	120
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	15	17½
" " " " pref.	15	15	17½
Fort Wayne Electric	100	1	2
General Electric	100	36⅛	36½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref	50	50½	51½

BONDS.

Edison Electric Ill., New York	1,000	106½	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197½	198
American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
Gold & Stock Telegraph	100	100	102
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	85	85⅛

* Ex. div.

NEW INCORPORATIONS.

THE CHELSEA ELECTRIC LIGHT COMPANY, Chelsea, Mich., capital stock $25,000 has been incorporated.

THE BIDDLE RAILWAY CAR ELECTRIC LIGHTING COMPANY, capital stock $500,000, has been incorporated.

THE NATIONAL UNION TELEPHONE COMPANY, San Antonio, Tex., capital stock $50,000, has been formed.

THE PORTABLE ELECTRIC LIGHT AND POWER COMPANY, Orange, N. J., capital stock $100,000, has been incorporated.

THE STANDARD TELEGRAPH AND TELEPHONE COMPANY, Cleveland, O., capital stock $50,000, has been incorporated.

THE BROOKLYN GAS AND ELECTRIC COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $10,000.

THE ARNOLD TELEPHONE COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated by S. G. Arnold, M. F. Marsh and W. Howard.

THE HINSON MANUFACTURING COMPANY, Chicago, Ill., capital stock $500,000, has been formed to manufacture electric motors and railway rolling stock, etc.

THE RED LINE TRACTION COMPANY, Chicago, Ill., capital stock $50,000, has been incorporated. R. V. McNelhis, Frank Keogh and T. J. Hodkins are the promotors.

THE VANDERWERKEN, RICKERSON & BRAINERD COMPANY, New York, capital stock $20,000, has been formed by A. Vanderwerken, C. L. Rickerson and H. J. Brainerd to manufacture electrical apparatus, etc.

THE HARRISON INTERSTATE TELEPHONE AND TELEGRAPH COMPANY, Frederick, Md., capital stock $25,000, has been incorporated by P. D. Fahrney, J. Baumgardner, J. E. Walker, F. B. Sappington and E. L. Miller.

THE ST. GEORGE ELECTRIC COMPANY, LIMITED, St. John, N. B., capital stock $100,000, has been incorporated by T. H. Estabrooke, A. P. Barnhill and Dr. M. Bird, of St. John, and A. T. Dunn and F. B. Dunn, of Mushquash.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Appleton, Wis., capital stock $10,000, has been formed to transmit electricity for light and power. The incorporators are M. H. Creswell, A. C. Lansstadt and J. A. Paterson.

THE NIAGARA GAS SAVING COMPANY, Niagara Falls, N. Y., maximum capital stock $16,000, has been formed to manufacture and sell gas, electricity, etc. W. C. Edwards, W. H. Orchard, and J. D. Lapp, all of Niagara Falls, are interested.

THE ST. GEORGE ELECTRIC LIGHT AND POWER COMPANY, St. John, N. B., capital stock $5,000, has been incorporated. The incorporators are J. Sutton Clark, T. O'Brien, A. S. Baldwin, J. Frawley, Dr. H. J. Taylor, J. Vogue and J. O'Brien.

THE ARKANSAS VALLEY ELECTRIC COMPANY, Denver, Colo., capital stock $50,000, has been formed to furnish electricity for light, heat and power to various towns. J. W. Stearns, Jr., G. A. Goddard and J. E. Johnson, Denver, are the promoters.

THE UNITED GAS AND ELECTRIC LIGHT COMPANY, Saratoga Springs, N. Y., capital stock $50,000, has been incorporated by C. E. Arnold, of Albany, and E. J. Slattery and E. H. Peters, of Saratoga Springs, for the purpose of supplying gas and electricity.

THE STURGEON BAY WATER WORKS AND ELECTRIC LIGHT COMPANY, Sturgeon Bay, Wis., capital stock $35,000, has been formed to furnish electric light and power. L. M. Washburn, T. H. Smith, W. J. Binks, and W. A. Lawrence are interested.

THE F. D. POTTER COMPANY, Albany, N. Y., capital stock $1,000, has been incorporated by D. W. Potter, Woldoborough, Me., and Wm. J. Newton and Jos. Hutchinson, New York City, to deal in electrical apparatus and machinery and to carry on the business of consulting engineers.

THE COHOES CITY RAILWAY COMPANY Cohoes, N.Y., capital stock $50,000, has been formed to operate a street surface electric railway five miles long, in that city. The organizers are Urban Weldon, M. Hubbard, E. W. Lansing, G. E. Simmons, J. Garside, T. O'Dea, H. Kahn, H. Graham, and G. H. Fitts, all of Cohoes.

THE YONKERS ELECTRIC RAILWAY COMPANY, Yonkers, N. Y., capital stock $1,000,000, has been formed to operate a surface electric road between Yonkers and New York. J. I. Bums, W. D. Baldwin, C. H. Montague, New York City; W. R. Hurd, Hartford, Conn., and D. N. Rowan, Irvington, N. Y., are the promoters.

THE SCENIC ELECTRICAL AMUSEMENT COMPANY, Jersey City, N. J., capital stock $25,000, has been formed to establish and operate scenic electric theatres and other electrical amusements. J. A. Seely, New York; P. J. Bennett, Brooklyn, N. Y.; W. H. Gandy, F. W. Roebling, Trenton, N. J., and C. H. Johnson, Montclair, N. J., are the incorporators.

THE ELECTRIC LIGHT, POWER AND WATER COMPANY OF SEA ISLE CITY, Sea Isle City, N. J., capital stock $50,000, has been organized to build and maintain electric, water, and other plants and stations for supplying light, power, heat, weater, etc. M. Boney, J. A. McCullough, J. McGuinness, J. Cowan, Philadelphia, Pa., and J. Haugh, Sea Isle City, are interested.

Special Correspondence.

NEW YORK NOTES.

NEW YORK, August 6, 1894.

G. A. BARNARD, superintendent of the Buckeye Engine Company, was in town last week on a business trip.

MR. P. S. BEMIS, JR., has resigned as Western representative of the Peckham Motor, Truck and Wheel Company.

ROLLEY LINE TO ALBANY.—It is reported that the electric road between Poughkeepsie and Wappinger's Falls is one link of a chain of trolley roads to connect Albany with New York.

C. S. VAN NUIS, 136 Liberty street, has recently received an order from a street railway company for 373,000 ampere capacity of Ajax switches, which is thought to be the largest order for switches ever placed for a similar purpose.

MR. MAXWELL M. MAYER, who designed all the new improved electrical apparatus for the Zucker-Levett Chemical Company, this city, and has occupied the position of electrical engineer for this company for the past four years, has

severed his connection, and is temporarily located at room 3.0, Electrical Exchange.

JOSEPH E. LOCKWOOD, president of the Michigan Electric Company, Detroit, has been spending a few days in New York recently. During a call at the offices of The Electrical World Mr. Lockwood stated that his company is receiving a very satisfactory number of orders for the extensive line of overhead material which it is now putting on the market.

ELECTRO-OZONE.—Commissioner Andrews is now considering a bid of $36,850 from the Wolf Electric Disinfecting Company for an electric disinfecting plant for Riker's Island. The city government is now paying the Wolf Company $128.57 a day, and $65 additional for each night to supply "electrozone" for disinfecting the island on a contract of three months from July 1.

MORTIMER NORDEN, manufacturer of fan motors, 136 Liberty street, met with a very serious accident while riding his bicycle last week near Fourteenth street, caused by his bicycle colliding with a heavy truck. Mr. Norden was struck in the breast by the tongue of the wagon with such force as to render him unconscious. He was taken to Bellevue Hospital, where his case is said to be considered very serious.

THE LARGEST ELECTRIC LAUNCH ever built in this country was shipped from the General Electric Launch Company's works at Morris Heights, N. Y., last week. The launch is 47 feet long, with oak frame, and hull, decks and cabin of polished mahogany. The boat has double screws, is propelled with two 4 h. p. motors and carries 136 cells of storage battery. Congressman Paul J. Sorg, of Ohio, is the owner. The launch will be used on Lake Chautauqua.

MR. CHARLES D. SHAIN, Eastern agent of the Siemens-Halske Company, while attempting to board a car on South street, New York, last Friday, fell and injured his right knee. Mr. Shain was taken to his office in a carriage where a physician found his injury serious enough to keep him at home for several days. The accident happened as Mr. Shain was on his way to Chicago to see about the company's plans since the burning of the Siemens-Halske works in the recent Chicago lumber fires.

MR. HENRY W. DARLING, who has been elected to the treasurership of the General Electric Company, was formerly a prominent dry goods merchant of Toronto, and was president of the Canadian Bank of Commerce, which has a capital of $7,000,000, and also five years president of the Toronto Board of Trade, which body under his administration became the leading commercial organization of the Dominion. Mr. Darling's business capacity has had a thorough test in the experiences of the General Electric Company for the past two years, and his selection for the position of treasurer confirms the impression he made upon this community as a man of extraordinary business ability.

New England Notes.

Branch Office of The Electrical World, Room 91, Hathaway Building, 620 Atlantic Ave., Boston, Mass., August 4, 1894.

WATCH HILL, R. I.—In all probability the Electric Street Railway Company will supply Water Hill next season with electricity for lighting purposes.

MR. GEO. F. MANSON, general superintendent of the Okonite Company, of New York, was a Boston visitor this week and looked as smiling and happy as ever.

MANCHESTER, N. H.—The Brodie Electric Company has been organized in this city with a capital stock of $25,000. President, J. Brodie Smith; treasurer, Walter G. Africa; general manager, Albert L. Clough.

RAPID TRANSIT.—General Hyde favors electricity as the motive power of the Meigs elevated system, but Captain Meigs has all along insisted that this cannot be done with profit and maintains that steam must be used.

MAYOR MATTHEW'S nominee for commissioner of wires, John R. Murphy, has been confirmed by a unanimous vote. It is expected that great progress will now be made in burying the wires in Boston.

THE PETTINGELL-ANDREWS COMPANY, of Boston, have opened an office in New York city at 39-41 Cortlandt street. It is the intention of Mr. Andrews or Mr. Price or some one of their capable representatives to be in New York all the time.

THE BELKNAP MOTOR COMPANY, of Portland, Me., reports exceptionally good business. Its extensive addition to its factory is rapidly nearing completion, when it will be able to supply more quickly the demand for its manufactures, large railway generators and motors in particular.

THE BOSTON ELEVATED RAILROAD COMPANY (the Meigs road), has organized by the election of officers and directors: General Charles A. Whittier, now of New York, but an old resident and prominent business man of Boston, has been chosen president of the company. Captain Meigs was, of course, elected as chief engineer.

THE AMERICAN BELL TELEPHONE COMPANY has filed its return for expenses incurred during the last session of the Legislature. According to the return, it cost the company very nearly $50,000 to secure its $30,000,000 increase of capital stock and to protect itself from adverse legislation. The company paid to the press of Boston and vicinity more than $13,000 to have the arguments of Hon. John D. Long and R. M. Morse, before the Committee on Mercantile Affairs, published in full.

MESSRS. G. G. CROCKER and A. C. Burrage are the new subway commissioners for Boston by nomination of Gov. Greenhalg. Both of the gentleman are posssessed of exceptional ability and integrity, and their nomination appears to meet with general approval. As counsel for the Brookline Gas Company and particularly for the Westinghouse Electric Company, in its issue with the Boston Electric Light Company before the Board of Aldermen, some years ago, Mr. Burrage is quite well and favorably known to the electrical fraternity.

MR. M. VON LOESECKE, a prominent mechanical and electrical engineer, has been engaged by the Davidson Ventilating Fan Company, of Boston, to manage its electrical and steam departments, and his valuable services will undoubtedly extend greatly its already excellent business. Mr. Loesecke has been actively engaged in the electrical business since 1881, holding responsible position, first with the N. E. Brush Company, leaving it to connect himself successively with the Thomson-Houston Company, the Thomson Welding Company and heGeneral Electric Company, all of which he served creditably.

Canadian Notes.

Ottawa, August 4.

OTTAWA, ONT.—The Ottawa Electric Street Railway proposes extending its line to Hintonburgh.

TORONTO.—A move is being made to extend a line of the Toronto Railway Company from the Junction to Weston.

TORONTO.—The Executive Committee has decided to call for tenders for machinery and plant for a civic lighting system. Lighting tenders are to be called also.

ST. JOHN, N. B.—Mr. Brothers says that the electric railway will employ from 350 to 400 men in laying the rails, and that the new line will be laid about the middle of October.

OTTAWA, ONT.—The Quyon, Coulonge and intervening points along the Pontiac & Pacific Railway are being connected by telephone. The contract has been given to the Bell Telephone Company.

GALT, ONT.—W. Y. Soper has handed over the newly constructed electric railway. The road is five miles long, the distance from either municipality being three miles. It is principally for freight purposes.

CALIDEN, ONT.—McLaren's mill here is to be run by electricity, generated over a mile distant at a water-power made by damming up a small stream, so as to give a good head of water. The dam is made of solid masonry, 25 feet high and very thick.

ELECTRIC RAILWAYS IN LONDON.—Work on the electric railway, which will run from Waterloo under the Thames into the city, has been commenced.

LONDON, ONT.—Mayor Essery has been in Toronto conferring with President Everett, of the London Street Railway. The City Council has refused to accept the company's latest offer for the electric franchise.

MONTREAL.—The next convention of the Canadian Electric Association will be held in Montreal next September. The convention will be held in the Mechanics' Institute Building and will last two days. The business part will comprise some important matters relative to the amendments to the constitution and by-laws. A number of important papers will be read and discussed.

SEAFORTH, ONT.—The Seaforth Electric Light Company is applying to the Ontario Government for a charter to establish a system of electric lighting and heating in the town of Seaforth. Capital stock is to be $25,000. Archibald Scott, James Scott and Francis Holmested are to be the first directors of the company.

MATTAWA, ONT.—The Mattawa Electric Light Company is applying to the Ontario Government for a charter for the purpose of establishing an electric plant in the town of Mattawa for lighting purposes. Colin Rankin, Chas. Hoeutschel, Robert Shanks, Louis Timmins and Robert Plow are to be the first directors of the company.

WINCHESTER, ONT.—W. R. Keating, of Kemptville, has been ascertaining what encouragement he could get in the matter of electric light if he were to establish a plant here. Sufficient lights were taken to about decide Mr. Keating to make a start. The Royal incandescent is the system. It is expected that he will begin operations about September 1.

TORONTO.—The first general meeting of the shareholders of the Toronto Suburban Street Railway Company was held here on the 31st of July, for the purpose of considering and confirming the agreements for the acquisition of the franchises of the City & Suburban Electric Railway Company, the Davenport Street Railway Company and the Street Railway Construction Company.

HAMILTON.—The quarterly check from the Street Railway Company has been received by the city clerk for the three months ending June 25, the amount being $3,325, made up as follows: Mileage, 1,000; percentage, at 6 per cent., on $29,168 of gross receipts, $1,750.08, less $25 on account of Herkimer street paving. For the same quarter last year the mileage was 1,404, and the percentage $1,729. a. m. to 9 p. m., and to furnish the material for paving the streets traversed.

THE T. W. NESS ELECTRICAL COMPANY, Carleton Place, Ont., with a capital of $150,000, has just been incorporated in Canada. The applicants for incorporation are: Thomas Ness, Peter Davidson, James Rankin, John Adams, and Norman McLaren, all of Montreal. The company seeks power to carry on throughout Canada the business of manufacturing, buying, selling and trading in every description of electrical apparatus and appliances.

MONTREAL.—The next convention of the Canadian Electric Association will be held in Montreal in the latter part of September. The convention will be held in the Mechanics' Institute Building and will extend over three days, one business session being held on the first day and one in the forenoon of the third day. The papers that will be brought before the convention include a paper on "The Possibility of Securing Better Regulation at Central Light and Power Stations by Means of Fly Wheel Accumulators of Improved Construction," by John Galt, C. E. and M. E., Toronto; and one on "A Method of Distribution with Equalization of Potential Difference," by D. H. Keeley, of the Government Telegraph Service.

THE CHAUDIERE ELECTRIC LIGHT AND POWER COMPANY, the Standard Electric Company and the Ottawa Electric Light Company, which have done business in Ottawa for many years, have ceased to exist separate as corporate bodies. Under the power received from the Dominion Government they amalgamated into one company, under the name of the "Ottawa Electric Company," which will carry on all the business of the former three. The authorized capital stock of the Ottawa Electric Company is $1,000,000, and the paid-up stock is $645,000. The Board of Directors of the new company are Thomas Ahearn, Hon. E. H. Bronson, M. P.; G. P. Brophy, G. B. Pattee, C. B. Powell, J. W. McRae, Robert Blackburn, Hon. Francis Clemow and William Scott.

English Notes.

(From our own Correspondent.)

London, July 24, 1894.

THE CITY & SOUTH LONDON RAILWAY.—The only interesting feature about the report of the directors of the City & South London Railway Company for the half year ending June 30 is the announcement that the company's engineer has been instructed "to make experiments with the view of substituting motors on the train itself in place of the present separate locomotive." As the running expenses per train mile have now become stationary at 6.2d. and the yield per train mile is also of a stationary character, the adoption of motive cars in place of separate locomotives would appear to be the only available engineer-

ing means of increasing the net income, at any rate until the extension northward has been carried out.

THE TELEPHONE AS A TELEGRAPH.—It is now some thirteen years ago that Mr. Justice Stephen decided that, in the eyes of the law as set forth in the telegraph acts Prof. Graham Bell's invention was a telegraph, and within the last few months the Post Office has taken steps to transform this legal fiction into a solid fact. The Post Office electricians are now busy all over the country, substituting telephones for the A. B. C. and needle instruments, which form the usual equipment of our country telegraph offices. The manipulation of the A. B. C. telegraph is, in all conscience, sufficiently simple, but with a view of enlisting in the telegraph service the whole family of every rural postmaster, the telephone is being substituted. If our telegrams from rural districts are to be transmitted verbally in future, important messages will have to be couched in simple words suitable to the idiosyncracies of the telephone, unless the recipients are to get a revised version of the messages sent.

News of the Week.

TELEGRAPH AND TELEPHONE.

SHARPTOWN, MD.—Address A. W. Robinson & Co. concerning estimate of cost for a nine-mile telephone line.

CORSICANA, TEX.—Address James I. Autry concerning a telephone equipment about to be purchased. A company is organizing to construct the telephone line.

WOMESLDORF, PA.—George Filbert has been elected president of the Groff Telephone Company, with main office in the Borden Building, Chicago, and the eastern office at Womelsdorf. The new company has been organized under the laws of Illinois and capitalized at $1,000,000. Elias Groff, treasurer, and William Filbert, secretary. Other officers who are Chicago men are W. B. Brissel, vice-president; I. B. Tabor, assistant secretary, and W. F. Bigelow, attorney.

ELECTRIC LIGHT AND POWER.

LANMARK, ILL.—A franchise is being asked for to put in an electric plant.

IOWA FALLS, IA.—Address the Mayor concerning a contemplated electric light plant.

WELLS, MINN.—The city voted to issue $20,000 in bonds for water works and electric lights.

MT. PLEASANT, IA.—The Council is considering the question of electric street lighting.

STOCKTON, N. J.—Councilman Gramer favors the town owning its own electric light plant.

MARION, IA.—The Council has granted to F. J. Hodges a franchise to put in an electric plant.

HUNTINGDON, N. Y.—Standard Gas and Eectric Light Company is reported in the hands of a receiver.

MIDDLETOWN, O.—The city is advertising for bids to light the city and city building with electric lights.

LE ROY, N. Y.—Le Roy will have a new electric plant to be put in by F. C. Rogers & Co., lumber dealers.

ROME, N. Y.—Address C. A. Fowler concerning proposals to furnish the city with 150 arc lights for one, three or six years.

ALLEGHENY, PA.—The city engineer has been authorized to advertise for bids for machinery for the electric light plant.

PALMYRA, N. Y.—W. D. Willcox, of Earlville, has secured a $10,000 contract for constructing an electric lighting plant here.

TEXARKANA TEX.—Bids will be received for a franchise for a system of water works and electric lights. P. A. Turner is mayor.

GLADWIN, MICH.—The Council on July 21 granted Messrs. Prindle & Schulz a franchise for thirty years for electric lighting and power.

CONCORD, N. C.—An electric pumping system will be put in by the Odell Manufacturing Company. F. L. Emery is superintendent.

VINELAND, N. J.—The Norton Parker Company have decided to run an overhead trolley in the foundry to carry iron around the building.

PATTEN, PA.—A scheme is on foot whereby Carrolltown, Hastings and Patton are to be lighted by electricity from a plant in the latter town.

SARATOGA SPRINGS, N. Y.—The United Gas and Electric Light Company, of Saratoga Springs, was incorporated with the Secretary of State.

GREEN LAKE, WIS.—Green Lake people are talking of putting in an electric light plant to light the resorts and furnish power for launches.

LAPEOR, MICH.—The Electric Lght Company is preparing to erect new poles, put in a new engine and dynamos and otherwise improve the plant.

CARDINGTON, O.—Proposals will be received for an electrical light plant complete, or engines and boilers separate from the rest of the plant.

ST. LOUIS, MO.—Supervisor of City Lighting A. J. O'Reilley is preparing plans for the location of 50 additional incandescent lamps in Forest Park.

RUMFORD FALLS, ME.—Mr. F. A. Danforth is preparing to erect a large grist mill which is to be run by an electric motor of 15 to 20 horse power.

CARDINGTON, O.—Plans and specifications have been prepared, and bids will be received on a complete electric light plant. Geo. W. Bowyer is city clerk.

STEELTON, PA.—The Electric Light Company was granted a charter. The capital stock is $10,000. The directors are M. G. Keller, D. Z. Witmer, J. C. Redsecker.

SPRINGFIELD, MASS.—A vote will be taken at the next city election on the matter of municipal lighting, as the city is receiving poor service from the electric light company.

BOWLING GREEN, O.—E. H. McKnight, president of the Bowling Green Electric Light Company, purchased three lots upon which his company will at once erect an electric light plant.

ROME, GA.—It is contemplated to develop the water power of the Etowah River and erect a plant for supplying electricity to the city. Z. B. Hargrove, J. W. Rounsaville and T. F. Howell are interested.

ROME, GA.—A company is being organized by Z. B. Hargrove, J. W. Rounsaville and T. F. Howell to develop the water power of the Etowah River and to erect a plant for supplying electricity to the city.

BRADFORD, PA.—The Bradford Electric Light and Power Company has been awarded the contract for the erection of a new electric light and power station, which will be one of the most complete in Western Pennsylvania.

EAST DUBUQUE, ILL.—Sealed proposals will be received until August 1 for the erection and completion of an electric light, water and fire house at East Dubuque, Ill. Proposals are to be addressed to the city clerk.

SYRACUSE, N. Y.—Edward Kanaley will erect an electric light plant at Edwards Falls, on Limestone Creek, near Manlius, to supply light and power to the villages of East Syracuse, Eastwood Heights, Fayetteville and Manlius.

BLOOMINGTON, ILL.—The special committee made its report advising the reconstruction of the electric light circuits, the purchase of a new dynamo, that 71 new lamps may be put in circuit. After the debate the report was adopted.

PERRY, IA.—A boiler in the water works station and electric light plant in this city exploded, totally wrecking the building and destroying the machinery The water works were owned by the city, and the electric light plant by a private company.

HARTWELL, O.—A stock company, with a capital of $20,000, is to be formed in Hartwell for the purpose of supplying electricity for street and commercial lighting. R. S. Waddell, who is mayor of the village, is at the head of the enterprise. Proposals are now being received.

CAMBRIDGE, O.—The report of the special committee on electric light was read, received and the committee discharged. The committee recommended the city to erect a plant to consist of two arc dynamos of 60-lamp capacity, and an incandescent dynamo of 1,000-lamp capacity.

BUFFALO, N. Y.—M. E. Beebe & Sons have prepared plans for a seven-story fire-proof building to be erected on Main and Washington streets, by Mooney & Brisbane. The building will be heated by steam and will be provided with an electric light plant. The architects will have general supervision of the work.

MIDDLETOWN, N. Y.—Sealed proposals will be received until August 8 for supplying for one or three years, from September 1, 100 arc lights, of 2,000 candle power each, or their equivalent in gas lamps or naphtha lamps; also price for each additional light. Lights to burn from dark until dawn, each and every night. Ira Dorrance is president and E. M. Hamilton city clerk.

TRENTON, ONT.—Tenders will be received until August 15 for the erection and furnishing of an electric light plant, including poles and wires, lamps, etc., and for erecting a power house on the water power owned by the town of Trenton, to be owned and operated by the municipality. Also a tender for lighting the town of Trenton, the tender to state price separately and to furnish his own plans and specifications. Geo. Crowe is chairman.

THE ELECTRIC RAILWAY.

POQUONOCK, CONN.—An electric road will be built here.

RINGTOWN, PA.—An electric railway between Ringtown and Shenandoah is being talked over.

CORTLAND, N. Y.—The directors of the electric road are talking seriously of extending their road to Little York.

UNION MILLS, MD.—Efforts are being made to organize a company to construct an electric railway through Leicester Town.

CHICAGO, ILL.—The Central Rapid Transit Company, capital stock $1,500,000, contemplates extending its lines to Dunning and Norwood Park.

TRENTON, ONT.—Bids will be received until August 15 for the erection of an electric power house. Geo. Crowe is chairman of the committee.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrows' Point Electric Railway survey has been completed. T. B. B. Gatch is president of the company.

MILL HALL, PA.—The people of the Mill Hall want the Electric Street Railway Company to light their town by electricity. The matter will receive consideration.

WASHINGTON, D. C.—The Metropolitan Street Railway Company bill was passed by the Senate, authorizing the company to adopt an underground electric system.

BALTIMORE, MD.—The City & Suburban Railway Company is preparing to secure a right of way for an extension of its electric road to London Park and Catonsville.

ANNAPOLIS, MD.—Local and Philadelphia parties are interested in a project to construct and operate an electric railroad from Annapolis to Bay Ridge and Arundel-on-the-Bay.

PAMAQUA, PA.—Work has been commenced on the Inter-County Electric Railroad. The road will run from Lansford and Summit Hill, and will connect with the Switchback.

LEIPERVILLE, PA.—It is rumored that a trolley line is to be built on the Swarthmore road, between Leiperville and Swarthmore, to connect the two main lines of the trolley system.

HAMMOND, IND.—Messrs. Talford, Burnham and Rand, McNally & Co. are projectors of a new street car line between this city and Chicago. Work will commence early next month.

LOCK HAVEN, PA.—Proposals are wanted for the erection of the power house and car barn of the Lock Haven Electric Street Railway. Plans and specifications may be had of R. H. Irvin.

LOWELL, MASS.—Work on the extension of the L., L. & H. Electric Road, from Glen Forest to Lowell, will be begun in about two weeks. When the line is completed the Lowell, Lawrence & Haverhill road will have a 60 mile track in operation.

NYACK, N.Y.—A meeting will soon be called for the purpose of forming a stock company with the view of building an electric railroad from Nyack to West Nyack, and eventually to Suffern.

NEW ROCHELLE, N. Y.—Work on the trolley road, that has been planned to run from Drakes avenue, through Huguenot street, will be commenced soon. It is expected to have the line in operation by October 1.

CHAMBERSBURG, PA.—It is said some capitalists are considering the feasibility of the construction of an electric railroad from Chambersburg to Scotland and thence to Green Village and back to Chambersburg.

WILMINGTON, DEL.—The Wilmington City Railway Company began preparations on Washington street, between Delaware avenue, for the single line of electric railway on the five squares between these two points.

LOCK HAVEN, PA.—The site for the power house for the new railway company has been decided upon, and the erection of the building will begin in a few days, to be finished by the time the railway is completed.

MEMPHIS, TENN.—The Raleigh Springs Railroad Company is reported purchased by A. M. Billings, of Chicago, and others. The road is 12 miles long and will be operated by the Citizens' Street Railroad Company.

CONWAY, MASS.—Conway citizens have already subscribed $25,000 for the new electric street railway to be built from the village to the railroad station. It is estimated that the road and all equipments will cost $50,000.

DANBURY, CONN.—The selectmen have at last voted to give the Danbury & Bethel Horse Railway Company permission to construct a trolley line on the town roads, in accordance with plans and specifications filed by the company.

SAN FRANCISCO, CAL.—The citizens of the Richmond district are enthusiastic in their endorsement of Adolph Sutro's proposed street railway through that section to the Cliff House. A meeting of the property owners and residents is to be held in a few days to take some action in aiding the project. Richmond citizens have been asked to subscribe for some of the stock of the new company and have signified their intention of doing so. Already $20,000 worth of stock has been placed.

CHICAGO, ILL.—The plans of the northwestern extension of the Lake street "L" road have been finally approved by the city authorities, and it is expected that work will soon commence on the new division of the road. The extension branches off the main line at Western and Stresian avenues, and covers a great stretch of territory.

POTTSVILLE, PA.—Sealed proposals will be received by the Schuylkill Electric Railway Company until August 9 for excavating the foundation for a car barn and machine shop. Also proposals for the completion of car barn and office from the foundation up, in accordance with plans and specifications made by Chas. P. Krieg, architect.

READING, PA.—Mr. Johnson introduced an ordinance granting the Reading & Southwestern Street Railway Company the privilege to extend its tracks on Franklin street eastward, and thence on certain streets, with the right to construct the necessary curves and turnouts, and to string overhead wires to operate the said extension or additional line of electric power.

Personal Notes.

DR. ALLAN J. HORNSBY will soon publish a book entitled "Electricity at the World's Fair," which will describe the various electrical features of the Chicago Exposition.

A CORRECTION.—In the personal mention of Mr. George Kirkegaard in our last issue we inadvertently stated that he was the inventor of the lamp being manufactured by The Solar Arc Lamp Co., of Brooklyn, and also organizer of the company. We desire to correct that statement, as it did injustice to Mr. Peter Kirkegaard, brother of the subject of our sketch, to whom these honors belong.

Miscellaneous Notes.

CABLE LITIGATION.—The English Court of Appeals on July 10 rendered a verdict in favor of the Anglo-American Telegraph Company and against the Compagnie Francaise du Télégraphe de Paris à New York, claiming damages for loss sustained in consequence of the rupture in 1887 of a pooling arrangement made six years previously. The court held that the Pouyer-Quertier Company should have sought the approval of the French Government before breaking the agreement, failing which it acted on its own responsibility and at its own risk. But as it was evident by the Ministerial despatch of May 21, 1891, that the French Government would not have given its consent to the fusion of the two companies, the Anglo Company were only entitled to damages for any injury it might have sustained through the rupture for the period between December 31, 1886, and May 21, 1891. The court was not able itself to assess these damages, and therefore referred the matter to MM. Flory and Verbeecque and a third person yet to be chosen, to determine the amount to be paid as compensation to the Anglo Company. The Pouyer-Quertier Company are to pay all costs up to and including this judgment, the question of further costs being reserved.

Trade and Industrial Notes

THE GENERAL ELECTRIC LAUNCH COMPANY, 44 Broad street, and Morris Heights, New York, has changed its name to the World's Fair Electric Launch Company.

E. GOTHBERG, 67 Centre street, New York, owing to a mistake of the printer, was quoted in our last issue as manufacturing and selling electric light fixtures, whereas his business is making chandelier trimmings, arc lights and fan covers, metal novelties, etc.

THE NATIONAL TELEPHONE MANUFACTURING COMPANY, of Boston, has just received an order for 1,000 receiver and transmitter telephones, for use in the new Hotel Majestic, New York City. This order speaks well for the efficiency of the National telephone.

THE SIEMENS HALSKE ELECTRIC COMPANY'S factory, Chicago, was burned last week, the loss being $50,000. All patterns and drawings were saved and we are informed that manufacturing was immediately resumed, and that deliveries will only be delayed 90 days.

H. H. MILLS, of Syracuse, N. Y., representing the Crouse Carbon Company, has recently been awarded contracts for furnishing the Syracuse Electric Light Company and the Utica Electric Light Company with carbons, both of which were awarded after strong competition.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY, 27 South Eleventh street, Philadelphia, informs us that its commutation switch, which has been advertised for the last two years, is exactly the same as that described in an article by Mr. Marchland in our issue of July 14, 1894.

W. R. BRIXEY has been exceedingly fortunate in carrying off World's Fair awards, having secured the only awards for telegraph and telephone cables, underground, aerial and submarine, and has just been informed that the highest award for insulated electric light wires has been allotted to him.

A. O. SCHOONMAKER, 158 William street, makes a specialty of India mica, claiming it to be the best in the market for all insulating work; but in order to meet the demand he is now offering to the trade a superior quality of Canada amber mica, cut, uncut and stamped for segments at lowest prices.

SAMUEL W. RUSHMORE, 126 Liberty street, New York, informs us that the six search lights for the Southern Pacific Steamship Company, to which we referred in these columns in our issue of July 28, were the well-known Huntington search lights that are also being made for the Scott Electrical Manufacturing Company.

THE JAMES LEFFEL & CO., of Springfield, O., has issued a fine and complete new pamphlet, illustrating and describing their well-known line of upright and horizontal steam engines and steel boilers, with latest improvements, which were awarded diploma and medal at the World's Fair. It should prove of value to all interested in this line.

W. C. STERLING & SON, one of the oldest cedar firms in this country, are prepared for a large business this year. They have received three large crib rafts of cedar poles at their pole yards at Monroe; one from Canada and two from Northern Michigan, including 30,000 poles, and expect to receive two more rafts during the summer. About 20 cars per week are also being shipped in and all are sorted, so as to be able to make prompt shipments. Their yard at Monroe is the largest in the world, and, besides this one, they have two more in Northern Michigan. Within the last month they have shipped 20 car loads to Texas, and are receiving orders that keep them very busy.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports signs of marked improvement in the electrical business, having on hand more work than at any other time for the last eighteen months. The recent sales of its standard belted and also of its new direct connected apparatus for lighting work have been very large, necessitating a large addition to their working force in their works at Manchester. The company also reports a very good business throughout the Western and Central States, in which territory it is well represented by its well-known Western contractor, J. Holt Gates, of 1,140 Monadnock Building, Chicago.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports the demand for its celebrated Paranite High Grade Wire to be steadily on the increase. Paranite is becoming particularly popular with the trade in general all over the West. Aside from the merits of the insulation this is due possibly to the fact that it is the only high grade rubber covered wire manufactured in the West, which leads to its support partly through local pride and also from the fact that all kinds of special orders can be furnished promptly, thus doing away with the delay in transit incurred where special orders have to be made up at Eastern factories.

THE HAZLETON BOILER CO., 716 East Thirteenth street, New York, has issued a neat pamphlet containing tabulated results of 24 tests of the Hazleton boiler, which were conducted according to the methods of expert mechanical engineers. One of these tests—of a boiler at the collieries of the Messrs. A. Pardee & Co., Hazleton, Pa., which developed 228.49 h. p.—showed an evaporation of 13.22 pounds of combustible from and at 212 degrees; six tests gave an evaporation of over 12 pounds of water, reduced to combustible and boiling point, 12 tests of between 11 and 12 points, and five tests between 10.64 and 11 pounds, the former being the lowest of all of the trials.

THE UNITED ELECTRIC CORPORATION, Minneapolis, Minn., has been incorporated for the purpose of manufacturing and dealing in all kinds of electrical machinery and appliances, but for the present will confine its operations to telephones and telephone supplies. The company is well organized and starts out under most favorable auspices, having the necessary sinews of war, capital and talent. Mr. Grant, the president of the company, is a prominent capitalist in the Northwest, while Paul Bossart is a favorably and widely known electrician and pioneer in the telephone business, while both Mr. John A. Finney and Mr. George R. Kibbe are well known in the electrical profession. To Mr. Finney a great measure of the success of the recent Northwestern Electrical Association is due.

WADDELL-ENTZ APPARATUS.—Clients and friends of the well-known Waddell-Entz apparatus will be glad to learn that arrangements have been perfected by which the manufacture of the Waddell-Entz dynamos and motors will be carried on with improved manufacturing facilities and on a more extensive scale than formerly. The machines will be built in Bridgeport, Conn., in a new shop fully equipped with the most improved tools and machinery, overhead traveling crane, etc., and the most ample facilities for turning out the highest class of mechanical work with promptness and despatch. Mr. Waddell still retains his connection with the enterprise, and the sales department will be in charge of Mr. J. A. Machado, who has been connected with the Waddell-Entz Company since its organization Correspondence and inquiries should be addressed to J. A. Machado, Agent, 203 Broadway, Mail and Express Building New York City.

THE SIEMENS & HALSKE ELECTRIC COMPANY of America, who for the last two years have been the most prominent advocates of large direct coupled units both for lighting and power service, are to be congratulated on their success in this line. The following list of railway plants erected or under construction speaks for itself. Garden City Construction Co., Chicago, four 620-h. p. generators, total 2,480 h. p.; West Chicago Street Railway Co., Chicago, three 2,000-h. p. and one 1,000-h. p. generators, total 7,000 h. p.; Johnson & Edwards, contractors for Nassau Electric Railway Co., Brooklyn, N. Y., three 667-h.p. generators, total 2,000 h. p.; Toronto Street Railway Co., Toronto, two 1,400-h. p. generators, total 2,800 h. p., City Railway Co., Dayton, O., three 400-h. p. gen-

erators, total 1,200 h. p.; Ringing Rocks Street Railway Co., Pottstown, Pa, two 135-h. p. generators, total 220 h. p.; Cincinnati Street Railway Co., Cincinnati, O., one 650-h. p. generator, total 650 h.p.; grand total, 16,400 h. p. The above table gives the rated capacity of these generators only, while those that have been in actual service have shown their capacity to stand an overload of 50 per cent. for hours, without harm or flashing on the brushes.

THE RIES SPECIALTY COMPANY, of Baltimore, Md., has made application for the appointment of a receiver to take charge of and close up the business of that company. Mr. Elias E. Ries, the president of the company, stated that the corporation is unable to successfully prosecute its business, owing chiefly to internal dissensions among some of its stockholders, and that the assets of the company are in danger of being wasted to the prejudice of the creditors. Hence the petition for a receiver, who has been appointed with the consent of all parties for the purpose of dissolving the corporation and making an equitable distribution of the assets among the creditors and shareholders. The company was incorporated June 16, 1890, and has been engaged in the manufacture and sale of several well-known specialties, including the Ries regulating sockets for incandescent lamps. The company owns a number of valuable patents, and a well-equipped manufacturing plant, occupying the entire building at No. 7 South Gay street. It is the intention of Mr. Ries to reorganize the company under more advantageous surroundings and to take up, in addition to the inventions now controlled by it, the manufacture of some additional specialties for which there is a large demand.

COMPLETE PORTABLE TESTING SETS.—Queen & Co., Incorporated, of Philadelphia, have for some years past manufactured a portable testing set comprising Wheatstone bridge, rheostat and galvanometer, and in 1891 filled a long-felt want by substituting a D'Arsonval galvanometer for the type with fibre suspension which had been used prior to that time. By means of the new form, measurements could be made close to dynamos and on shipboard or other places, subject to vibration, and where earlier apparatus could not be used at all. Last year, recognizing the desirability of extreme compactness, Queen & Co. re-designed their series of testing sets and produced the "Acme" form. It is the smallest and most complete instrument of its class made anywhere in the world, and contains a Wheatstone bridge with reversible arms, rheostat, D'Arsonval galvanometer, double contact key and also a silver-chloride battery. The latter is sufficient for all resistances up to 200,000 ohms, so that for work below this limit the instrument is self contained. The coils are wound with platinoid wire, calibrated to a guaranteed accuracy within 1-5 of 1 per cent. and the galvanometer of the highly favored D'Arsonval form. This set has been approved by the U. S. Government for marine service, and received the highest World's Fair award. During the past two weeks the orders for testing sets received by Queen & Co. have materially increased, so that this may indicate something of a revival in general business.

HARRISBURG IDEAL ENGINES.—W. R. Fleming & Co., representatives of the Harrisburg Foundry and Machine Works in New York and New England, have handed us a list of engines for electric purposes for which they have taken contracts since May 1. Considering the dullness and general depression in business and the undoubted decrease in the bulk of general trade, the record is a most excellent one: One 200-h. p. Ideal tandem compound engine, direct connected to a Siemens-Halske generator, for the Broadway cable road; two 40-h. p. simple engines for friction driving Thomson-Houston dynamos for the new 250,000,000-c. p. lamp for the Fire Island light house; one 60-h. p. Ideal for the Stevens Apartment House, New York; two 100-h. p. deal direct connected to 50-k. w. General Electric dynamos, for the new hotel corner Seventy-second street and the Boulevard, New York; one 60-h.p standard Ideal for the American Tobacco Company, New York; four Ideal aggregating 500-h. p., arranged for direct connection to General Electric M. P. dynamos for the new Hotel Jefferson, Richmond, Va.; one 40-h. p. standard Ideal engine, boiler and complete steam plant, for Messrs. Kibbe & Co., Hartford, Conn.; one 60-h. p. standard Ideal engine, boiler and complete steam plant for electric sewage purification, for Danbury, Conn.; two 60 h. p. Ideal arranged for direct connection, for the new City Hall, Brockton, Mass.; one 70-h. p. standard Ideal for Bangor Steamship Co.; two 40-h. p. Standard Ideal for new steamships of Old Dominion S. S. Co.; one 70-h. p. Ideal for Lyceum Theatre, Boston; one 80-h. p. Ideal, being the third order, for the Nichols Chemical Co., New York; two 100-h. p. Ideal for the plant of the U. S. P. O. at Brooklyn; one 150-h. p. engine, boiler and complete steam plant for Havana; one 50-h. p. Ideal for Brooklyn Electric Equipment Co., Brooklyn; two 80-h. p. direct connected for the New York Electric Equipment Co.; one 50-h. p. Ideal engine, boiler and complete steam plant for A. W. Burchard; one 45-h. p. engine, boiler and complete steam plant for C. E. Corwin, New Haven, Conn.; one 150-h. p., two 100-h. p. and one 60-h. p. Ideal for General Electric Co., New York City; one 75-h. p. Ideal for C. N. Knox, Hartford, Conn.; one 50-h. p. standard Ideal for J. B. Herreshoff, New York; one 50-h. p. Ideal for Atlanta (Ga.) Water Works; two 100-h. p. standard Ideal for Morrison Southern Electric Construction Co., Baltimore, Md. The contract has also been awarded to Messrs. W. R. Fleming & Co. for supplying the station equipment of the complete central lighting and power station plant for the Port of Spain, Island of Trinidad, West Indies. This plant consists of four 250-h. p. tandem compound Ideal engines, four Harrisburg high pressure steel tubular boilers with Weitmeyer furnaces, two 2,000 light incandescent dynamos, two 50 arc machines, and one 100 kw. railway generator.

Business Notices.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 31, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

11,433. ELECTRIC ARC LAMP; Joseph B. McKeown, Cleveland, O. Application filed May 22, 1894. In an electric arc lamp the combination of a tubular rod suspended in the chimney by cords attached to the top end and passing over pulleys, in top of chimney; a counterbalance weight ring attached to the opposite end of said cords; guide wheels secured in the casing; armature suspended inside of said tube and the electromagnet outside of the tube and connected in the electric circuit, and adapted to operate substantially as described.

523,653. INSULATING BLOCK; H. P. Ball, Bridgeport, Conn. Application filed May 21, 1894. An insulating trolley guard wire block formed in sections having on each of their meeting faces a longitudinal groove for the guard wire and semi-circular opposing projections and recesses with extensions parallel with the guard wire groove on their meeting faces and on opposite sides of the guard wire grooves, the projection and its extensions on the opposite face, and span wire grooves on the exterior of the blocks transverse to the guard wire block.

523,662. ELECTRIC METER; Eugene Hartmann, Frankfort-on-the-Main, Germany. Application filed March 23, 1893. The combination with a wattmeter, a spring attached to an arm extending from the meter, a contact point, an electromagnet, clockwork for intermittently expanding the spring, a counter mechanism containing a wheel and carried by the armature of the electromagnet and roller.

523,663. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; J. Hoffman, Schenectady, N. Y. Application filed December 21, 1893. This consists in covering the bar with insulating material molded thereto under heat and pressure so as to become firmly adherent.

523,667. DYNAMO-ELECTRIC MACHINE OR MOTOR; W. H. Knight, Lynn, Mass. Application filed January 9, 1894. In a dynamo electric machine, as a means of equalizing the potention of the armature, a differential winding adapted to demagnetize the poles to which the armature runs in greatest proximity, in accordance with the increased electromotive force developed in such armature.

523,685. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; H. G Reist, Lynn, Mass. Application filed September 15, 1893. In combination a commutator, positive and negative brushes thereon, each brush covering more than one segment, and connections affording multiple paths for the current between the positive and negative brushes, each of the paths containing a set of series-connected coils.

523,689. PROCESS OF MAKING SECONDARY BATTERY PLATES; W. L. Silvey, Dayton, O. Application filed September 22, 1892. This consists in immersing anodes and cathodes in a solution containing a combination of acetic acid and potassium, subjecting them to the action of an electric current while in this solution, whereby the anode is oxidized and deposited on the cathode in a metallic state, then removing the cathodes from the depositing bath and compacting the deposit and then washing them in water and placing them in a solution of sulphuric acid and water and charging them with an electric current, thus producing positive electrodes.

523,695. ELECTRO EXPANSION DEVICE; Elihu Thomson, Lynn, Mass. Application filed Nov. 25, 1887. The combination of a closed receptacle entirely filled with expansible liquid, and provided with a yielding wall or side, a heating coil arranged around the exterior of said receptacle and a non-conducting case or cover inclosing said receptacle and its surrounding coil. (See illustration.)

523,696. DYNAMO-ELECTRIC MACHINE; Elihu Thomson, Swampscott, Mass. Application filed March 19, 1894. In a multipolar dynamo electric machine or motor, a multiple wound armature, series windings upon the field magnet poles taking current from such multiple wound armature, and means adapted to equalize the induction action of such field magnet poles upon the armature.

523,697. ARC-RUPTURING DEVICE; G. T. Voorhees, Boston, Mass. Application filed May 8, 1893. In arc-rupturing apparatus, the combination of electrodes or terminals with an insulator supporting the electrodes or terminals and a circuit looped inclusively around the terminals and supported by the insulator.

523,701. AUTOMATIC CIRCUIT CLOSER; J. W. White, Providence, R. I. Application filed March 11, 1893. In a case, a coiled spring; its inner support within and near the middle of the case, its outer support outside of the case, and an electrode insulated from and within the case.

523,704. ELECTRIC METER; T. Duncan, Fort Wayne, Ind. Application filed March 14, 1894. The combination of the series or inducing field coils, the aluminium armature or closed revoluble secondary and an adjustible diverter for determining the speed and direction of the rotation of the armature.

523,723. RAILWAY SIGNAL; F. E. Kinsman, Plainfield, N. J. Application filed February 1, 1893. In an apparatus for controlling the movement of railway trains, the combination of a section of rails, an electromagnet included in the circuit between the rails at one end of the section, a train controlling circuit between the opposite ends of the rails, a battery and series of electromagnets included therein, a switch controlled by each of the magnets in series and a branched supplemental circuit, of which each branch includes one of the switches, together with a supplemental battery

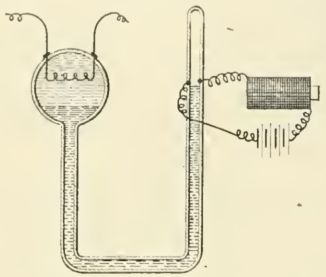
523,724. ELECTRIC SWITCH; G. E. Linton, Worcester, Mass. Application filed March 22, 1894. In an electric switch, the combination of a switch-board, binding posts having tapering walls ending in a groove, U-shaped springs provided with apertures in their middle portions, threaded screw holes in the bottom of the recesses between the walls of the binding posts, tapering headed screws to secure and adjust the springs between the walls and a tapering milled surface lever blade pivoted at one end to the switchboard, and having cut away portions at the other end, and blade portions to contact with the U-shaped springs on the binding posts.

523,758. GALVANIC BATTERY; C. E. Buell, North Plainfield, N. J. Application filed December 24, 1892. A gravity battery consisting of a vessel charged with undissolved sulphate of copper and water and provided with a copper electrode and an iron electrode.

523,767. ELECTRIC SIGNAL FOR RAILWAYS; C. A. Hammond, Boston, Mass. Application filed April 12, 1894. This comprises essentially two distinct normally open track circuits extended in opposite directions from one and the same insulated track section, which each of them includes, to points within the limits of the adjoining sections; in combination with a track battery for each track circuit, a train operated mechanical circuit closer located in each of the extensions and contacts controlled by the same.

523,776. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; H. E. Parshall, Lynn, Mass. Application filed January 31, 1894. An armature core comprising two or more sections or bundles of laminæ, ribs or separators between adjacent sections, and transverse channels through said sections from one side to the other thereof. (See illustration.)

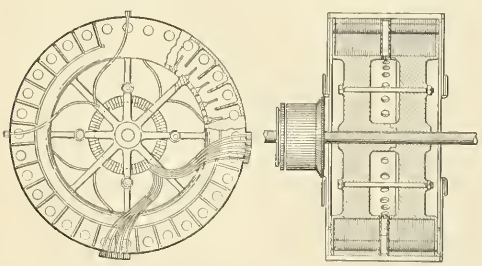
523,779. ALTERNATING CURRENT GENERATOR; E. W. Rice, Jr., Swampscott, Mass. Application filed July 25, 1893. In a generator for two-phase electric currents, the combination with a separately excited field coil, of an auxiliary field coil connected to the brushes of a current rectifier in circuit with both phases or impulses or current, whereby the field is variably excited in accordance with the work. (See illustration.)



No. 523,695.—Electro Expansion Device.

523,805. ELECTRIC CONVERTER; J. A. Cabot, Cincinnati, O. Application filed September 22, 1893. An electric converter shell, consisting of a series of soft metal plates, placed one upon another and pierced with cruciform slots, in combination with a number of readily detachable H-shaped cores, wrapped with insulated primary and secondary wires and inserted within said slots, heads applied to the ends of said shell, and fasteners that retain said heads in place.

523,822. ELECTROMAGNETIC RECIPROCATING PUMP; Charles J. Van Depoele, Lynn, Mass. Application filed December 12, 1891. The combination with a continuous current generator having stationary main positive and negative commutator brushes, of a pair of auxiliary brushes adapted to be rotated about the commutator toward and away from the stationary brushes, a reciprocating brush-shifting motor, an electromagnetic reciprocating pumping engine having a continuous current coil or coils in circuit with the stationary commutator brushes of the generator, and alternating current coils in circuit with the moving commutator brushes thereof, a switch mechanism actuated by the moving part of said pumping engine, and circuits and connections between said switch and the brush-shifting motor whereby the reciprocations of the pumping engine control the movements of the moving brushes and the reversals of current in the alternating current coils.

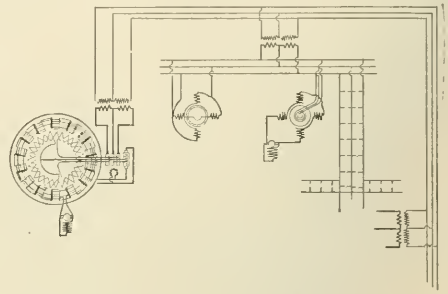


No. 523,776.—Armature for Dynamo Electric Machines.

523,847. ELECTRIC SIGNALING APPARATUS FOR RAILWAY TRAINS; W. H. Baker, Pawtucket, R. I. Application filed May 31, 1894. In an electric signaling system for railway trains, an attachment for the air brake hose couplings, the same comprising a supporting block formed to fit the side of a coupling member and having a cavity in the side toward the latter, a block of insulation filling said cavity and having one side exposed substantially in the plane of the inner face of the coupling, a binding post in said insulation and a contact plate on the exposed face of the same and in electrical connection with the said binding-post.

523,865. TESTING DEVICE FOR ELECTRIC CIRCUITS; G. A. O'Neill, Boston, Mass. Application filed October 20, 1893. A series of normally open main circuits, manually operated closures therein, a local alarm circuit, and a retarding mechanism therein normally responsive to an abnormal closure of a main circuit, combined with a manually operated actuator for and to render the retarding mechanism responsive to any closure of a main circuit, and a detent for said mechanism, whereby the alarm circuit is maintained operative after the main circuit is reopened.

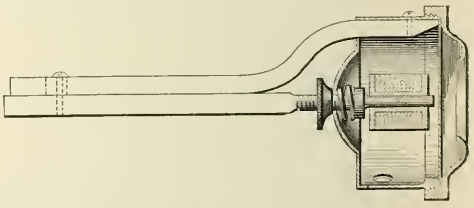
523,873. FLUID PRESSURE REGULATOR; Curtis H. Veeder and Edward D. Priest, Lynn, Mass. Application filed January 6, 1894. The combination with a fluid controller having a valve for opening and closing communication between a fluid reservoir and a fluid motive device, of an electromagnetic mechanism for operating said valve through connections permitting the fluid pressure or said mechanism to move said valve independently of each other.



No. 523,779.—Alternating Current Generator.

523,889. AUTOMATIC LINE DISCHARGER; Jacinto Ferrer Ganduxer, Gracia, Spain. Application filed November 4, 1892. In a line discharger the combination of the magnet provided with a notched pole, the bent armature lever carrying the armature, the retractile spring, the contact screws, arranged at right angles to the axis of the magnet and the line connections.

523,892. GALVANIC ELEMENT; Albrecht Heil, Crumbach, Germany. Application filed September 27, 1893. A galvanic element consisting of the combination of parts hereinbefore specified, viz.: a silver electrode attached to a lead support sealed through the cover and embedded in a mixture of carbon and peroxide of manganese, inclosed in a linen bag, a felt cylinder or diaphragm surrounding the same, and adapted to be saturated with a suitable liquid, and a zinc electrode.



No. 523,927.—Magnetic Telephone.

523,893. BUSHING FOR ELECTRIC ARC LAMPS; T. J. Houck, Baltimore, Md. Application filed April 29, 1894. An adjustable bushing for the carbon holders of electric arc lamps, having longitudinal slits forming spring tongues, and having upon its exterior a tapering screw thread adapted to compress said spring tongues when screwed into a socket.

523,798. MEANS FOR TESTING ELECTRIC SIGNAL BOXES; J. F. Mehren, Chicago, Ill. Application filed November 24, 1893. In an electric signaling box, the combination with a main-line circuit containing a signaling device and a relay, of a branch circuit containing a portion of the wire windings of the relay, said branch circuit being adapted to be connected into and out of shunt with the signaling device.

523,927. MAGNETIC TELEPHONE; F. H. Brown, Chicago, Ill. Application filed November 25, 1893. In an electrical telephonic apparatus, the combination with the diaphragm thereof, of a magnet arranged in juxtaposition to said diaphragm, said magnet being composed or made up of two members providing two extensions, which extensions are joined and held together and constitute one pole piece of one given polarity, and also two arms or pole pieces of the same polarity, one of which is in electrical contact with the diaphragm at or near its perimeter and the other located in such a position as that said diaphragm is adapted to vibrate within its field of force. (See illustration.)

523,946. BANK SAFE; Daniel M. Rothenberger, Lancaster, Pa. Application filed May 17, 1893. In a safe, the combination with an air chamber surrounding said safe, of an alarm, a connection between the air chamber and the alarm, whereby said alarm is sounded by forming an opening between the air chamber and the outer air, an escape-pipe leading from the air chamber, and an automatically opening spigot, held in a position to close said pipe by combustible cord passing around the safe.

523,957. ELECTRICAL WELDING OR BRAZING MECHANISM; G. D. Burton, Boston, Mass. Application filed June 3, 1893. The combination of an electric generator, an electric circuit containing it, a rheostat, an electric arc welding or brazing mechanism consisting of a conducting pencil forming the extremity of one member of the circuit and an electric conducting clamp forming the extremity of the other member of the circuit and arranged to be connected to the metal to be welded or brazed, and liquid containing cells introduced into the circuit, the positive wire of said circuit leading directly from one cell to the conducting pencil, and the negative wire of said circuit from the clamp directly to the other cell.

The Electrical World.

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CONTENTS.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The forty-third meeting of this association convenes in Brooklyn on Wednesday of this week, with every prospect for a most successful meeting. The program, which, so far as it is known, will be found in another column, gives evidence of every effort on the part of the officers of the association to make the gathering both a pleasant and profitable one. The sketch of the organization, by Dr. William H. Hale, president of the Resident Members Committee, from its birth in 1848 down to the present day, will doubtless prove of general interest. It will be seen that the general plan of the society resembles that of the British Association, although of more modest proportions and influence.

ENGINE REGULATION EXTRAORDINARY.

According to a recently published statement of Mr. Gisbert Kapp, clocks are run by small synchronous motors taking current from the Cologne, Germany, electric light stations, and keep correct time. As the time-keeping qualities depend only upon the speed of the engines, this implies most remarkable regulation of the latter. How remarkable this regulation must be is apparent from the fact that a variation of one per cent. in the speed of the engines in one direction would mean a change in the time of over a minute an hour. It is probable, however, that the station clock acts also as a counter, and automatic means are not entirely depended upon to keep this clock in synchronism with the ordinary station time piece.

THE BRITISH ASSOCIATION AT OXFORD.

The Oxford meeting of the British Association, which opened on Wednesday, August 8, bids fair to be one of the most interesting sessions since the last Oxford meeting, which took place in 1860, and which was made celebrated by the vigorous defence of the doctrine of Darwinism by Prof. Huxley. The sections of Mathematical and Physical Science (A) and Mechanical Science (G) are, perhaps, the only ones of special interest to electricians. Section A has generally absorbed most of the attention of the electrical profession, but this year the honors seem to be about evenly divided between A and G, with possibly a balance in favor of the latter. In another column we are able to present a synopsis of the proceedings as received by cable from The Electrical World's special correspondent, from the opening of the session up to and including Monday, August 13, the day The Electrical World goes to press. A number of important electrical papers have already been presented and the discussion participated in by men prominent in the electrical field. The attention of the eminent scientists seems to have been occupied for some time with Mr. Maxim's flying machine, this ingenious invention having no less distinguished champions than Lords Kelvin and Rayleigh.

SINE FORM OF CURVES OF ALTERNATING E. M. F.

It is seldom that we find it necessary to disagree *in toto* with our esteemed London contemporary the "Electrician," but notwithstanding the ability with which it has clung to its opinion as the non-efficacy of the sine form of curves of alternating E. M. F., we have not been able to see anything but hopeless error in its views of this subject. In our issue of last week and elsewhere in the present issue several correspondents whose opinions have an authoritative value confirm the views we have expressed and offer an accumulation of evidence, both theoretical and experimental, which should definitely settle the question. The very neat general mathematical demonstration of Mr. F. W. Dunbar complements the special deduction in Kennelly's Institute paper on impedance, while the other letters bring to bear an accumulation of evidence that takes away every vestage of ground for the opinion which they contest. From both

the theoretical and the practical standpoint it can be considered as definitely established that the sine form of curves of alternating E. M. F. is the best for the reasons that it involves less inductive drop and less iron losses in transformers and is absolutely necessary in motor work to avoid deleterious reactions from the upper harmonics otherwise present. To these advantages may be added the further one recently referred to by us in commenting on some German experiment with alternating arcs, which is that for the practical working of such arcs the sine curve insures smoother operation of the mechanism and a minimum of noise.

ELECTROLYTIC CORROSION OF IRON PIPES.

An interesting paper recently read by Prof. D. C. Jackson before the Western Society of Engineers takes up the question of the corrosion of iron pipes by the action of electric railway currents and the conclusions arrived at are of considerable practical interest. Prof. Jackson expresses the opinion that with a perfect return system properly connected to underground pipes electrolytic disturbances may be made to practically disappear. In order to determine as exactly as possible what occurs in the soil due to the return current a series of laboratory experiments were performed in which the practical conditions were reproduced as nearly as possible. As the result of many experiments he concluded that in no case is the action due to the electrolysis of water, and where oxygen is liberated at the anode, it does not attack the iron; that only a mere directive force in the nature of a pressure will cause electrolysis; that the actual corrosion is therefore only dependent upon the actual current which flows, and is as much dependent upon the resistance of the soil as upon the pressure tending to cause the current; that only a minute quantity of soluble salt is sufficient to start the action, and it will then continue as long as a current flows; and that the gravity of a corrosion of a pipe depends on the amount of current flowing from a given area and the nature of the salts present in the soil, the order of the activity of the salts being (1) chlorides, (2) nitrates, (3) sulphates. The statement that there is no evidence of direct electrolysis of iron, but that corrosion is the result of electrolysis of chemical compounds which are held in the water or the soil, setting up secondary chemical reactions, seems to explain the enigma of electrolysis with exceedingly small E. M. F's., but a quantitative demonstration of this process would be of much interest. It would appear that the difficulties to be overcome in order to get rid of corrosion are not so great as generally supposed, though success depends much upon a special study of the conditions of each case. In Madison it required an expenditure of only $8,000 to do entirely away with all trouble, and this would have probably been considerably less if proper precautions had been taken when the track was first put down. It remains for time to prove, however, the durability of the numerous connections necessary to be made, but this is a minor problem and of little moment compared with the one whose solution involves it.

ELECTRICAL INSURANCE INSPECTION.

We print elsewhere a letter referring to some unsatisfactory features of underwriters' electrical inspection, encountered by our correspondent, and whose experience, we trust, is an unusual one. We occasionally hear of somewhat similar cases, but since the general adoption of the insurance rules formulated by the Underwriters' International Electric Association, any dissatisfaction expressed has seldom any reference to the character of the rules, but, as in the present case, to the manner in which they are enforced by inspectors. It is an axiom that nothing can be accomplished by making laws, however excellent in themselves, unless the necessary provision is added for their proper enforcement, and this applies generally to any measure that proposes to make men do what otherwise they might think it to their interest to leave undone. The mere provision of agents to enforce laws does not in itself, of course, imply that the desired end will be attained, and it is in this respect that electrical insurance inspection is weak. The code of insurance rules now almost exclusively adopted in this country, has, we believe, the respect of the great body of electricians whom it affects, which has been secured by an unusual deference to the practical side of electrical construction work, and yet presumably with no sacrifice of the insurance interests which it was the object of its framers to safeguard. This in itself is no mean accomplishment and is the more noteworthy when contrasted with similar work in other countries. If all insurance inspectors were as competent as those who assisted in preparing this set of rules, the situation as to electrical insurance inspection would be an ideal one, but unfortunately this does not appear to be the case. It is within the power of few local boards to obtain the services of men competent to properly interpret and apply the spirit of the insurance rules, and such boards in case of charges of incompetence or collusion have not the technical knowledge upon which to arrive at a proper conclusion and are invariably inclined to back up their man. With, however, a general supervisory inspection service, much of the evil now complained of could be avoided. To the supervising inspector of a district conflicts between local inspectors and contractors could be referred with the assurance of a correct decision. To him the local inspector could apply for information in regard to the interpretation of rules or for guidance in cases not exactly covered by them. By personal instruction to local inspectors, checked by periodical inspections of work passed or condemned, electrical insurance inspection would thus be placed upon a plane of high efficiency and the collusion now so often charged between inspectors and contractors would be rendered extremely difficult, and the kind of work referred to by our correspondent would cease to be as frequent as it now is. The supervising inspectors by having all special cases and conflicts brought to their attention would constitute an ideal general body for the revision of rules, and in an art in which the applications are constantly undergoing such rapid changes the value of this feature is evident. We are aware, of course, of the difficulty there might be in getting the numerous competing insurance companies to thus unite in a general supervisory service, but the results to be expected would seem to offer the necessary inducements. We are also aware that the International Electric Association is doing excellent work in constantly collecting data and profiting by the experience of its members with a view of keeping its rules always up to date, but the same work if performed by a body with executive powers acting under full authority from the insurance interest would have a quicker and more effective application. Assuming what we have no reason to doubt, that our correspondent correctly reports the result of his experience, the conclusion is that while we have a code of electrical inspection rules efficient in themselves, the present system of inspection is such as to largely nullify the benefit that might be derived from them. While the formulation and general adoption of these rules was a great step in advance, the subject of inspection, aside from rules, is yet left open for vast improvement. We will take advantage of this occasion to correct a statement in a recent editorial on the same subject, which repeated a newspaper error, to the effect that the city authorities of Hartford had made an investigation of electrical wiring and found numerous instances of dangerous work. We are informed by the city engineer that the investigation was not carried on by the city but by the insurance interest, and we have learned further the significant fact that Hartford, where such an unsatisfactory state of affairs was discovered, is one of the few places that has refused to adopt the rules of the International Electric Association.

The Hatchet Planimeter.

Some further information regarding this little instrument, which we described and discussed in our issues of April 14 and June 30, may be found in abstracts of some recent Physical Society papers in the Lond. "Elec.," July 6. Prof. Henrici stated that the fact that it gave only approximate results was due to the area of the curve traced by the keel not being equal to zero; but he showed that in a curve that was symmetrical about a line, it is possible to reduce this error practically to zero. Mr. Hill recommends starting at the centroid of the area, but, in his opinion, the instrument can never be strictly accurate, although the errors are within the limits of observation. Prof. Henrici did not agree with the statement that the instrument was necessarily inaccurate.

Henri Poincare.

Henri Poincaré was born at Nancy, in France, April 29, 1854, his father being a medical professor in the college of that city. In 1873 he entered the Polytechnic School at Paris, and in 1875 the School of Mines. In 1879 he graduated as Ingenieur des Mines, received the doctor's degree, and was appointed a professor in the Faculty of Science of Caen. Two years afterward he was called to the Faculty of Science of Paris to be an instructor, where, in 1884, he received charge of a course, and in 1886 was appointed professor of mathematical physics.

In 1887 he received the high honor of being elected a member of the Institute of France, and in 1893 was appointed a member of the Bureau des Longitudes.

His principal work as an investigator has been in the region of pure analysis and applied mathematics. A large number of elegant memoirs from his pen have appeared since 1882 in the *Acta Mathematica*, a journal of pure mathematics, published under the auspices of Oscar II., King of Sweden. These memoirs fall into two groups; the earlier group are concerned with the functions of Fuchs and allied subjects of pure mathematics; the later group deal with problems in celestial mechanics. One of the later group —Sur le Probléme des Trois Corps et les Equations de la Dynamique—was successful in a contest for a prize offered by the King of Sweden. Poincaré's work in pure analysis has received high praise from mathematicians of the first rank, such as Professor Sylvester. It is said that Sylvester went over to Paris to see Poincaré; when asked on his return what he thought of Poincaré, he said that he could only stand at a distance and admire.

Poincaré

His other works consist of courses of lectures originally delivered by him as Professor of Mathematical Physics to the Faculty of Science, Paris. They are published by Georges Carré, Paris, and the titles of those already published are:

Théorie Mathematique de la Lumière, 1889.

Electricité et Optique, 1890 and 1891.

Elasticité, 1892.

Thermo-dynamique, 1892.

Théorie des Tourbillons.

Another volume, on the Theory of Electrical Oscillations, is in the press.

The first volume contains a critical discussion of the undulatory theory of light, the connection between it and the electromagnetic theory of light being reserved for the second volume.

It is with the second volume of the series that electricians are mostly concerned. It consists of two parts, of which the first is devoted to the theories of Maxwell and the electromagnetic theory of light, and the second to the theories of Helmholtz and the experiments of Hertz.

In the introduction to the first part he mentions the difficulty, not to say repugnance, experienced by Frenchmen on taking up Clerk Maxwell's Treatise, and he explains this phenomenon by the circumstances that they have been accustomed to precision and logical order in the works of the French physicists, from Laplace to Cauchy, while these qualities are absent in the works of Maxwell. But it is not Frenchmen only who have experienced difficulty in grasping Maxwell's theories; physicists to whom the English language is mother tongue have formed clubs for the study of Maxwell, pretty much after the manner in which literary people club together to study Browning. Whether the difficulty lies in the subject matter, or in the mode of exposition, or in both, it is there. Now, Prof. Poincaré has studied Maxwell thoroughly and he gives the result of his study not only orally to his students, but in book form to a wider circle of physicists.

His volume consists of critical discourses written with all the precision and logic characteristic of the French analysts. He points out that Maxwell does not give a mechanical explanation of electricity and magnetism, but confines himself to showing that such an explanation is possible. Maxwell shows that optical phenomena are only a particular case of the electro-magnetic phenomena. From every theory of electricity there can be deduced immediately a theory of light; but the converse is not true—from a complete explanation of light it is not always easy to derive a complete explanation of the electric phenomena. He considers the following to be Maxwell's fundamental idea. To demonstrate the possibility of a mechanical explanation of electricity we have not to find the explanation itself, it suffices to find the expressions for the two functions T and U, which are the two portions of the energy, to form with these two functions the equations of Lagrange, and finally to compare the equations so obtained with the experimental laws.

Poincaré endeavors to make the idea of electric displacement more determinate by introducing two alternative hypotheses, one that there are two fluids, electricity itself, and a *fluide inducteur;* the other that a dielectric has a cellular constitution.

The second part of "Electricité et Optique" contains an exposition in a uniform notation of the electro-dynamic theories of Ampère, Weber, Helmholtz and Maxwell, showing wherein they agree, and where they diverge, and it concludes with an elaborate test of the conformity of their several conclusions with the results of the experiments of Hertz.

The character of the physical and electrical work of M. Poincaré is largely determined by the fact that he is by training and habit of thought a Cartesian analyst. Maxwell was by training an experimenter, and was accustomed to think as a physicist rather than write as an analyst. One of the Cambridge tutors said of him when a student, "It is impossible for that man to think erroneously on a physical subject." The Cartesian analysis was not the instrument, but the expression of his thought. It may be said that he thought *in vectors*, and in this M. Poincaré does not follow him. If we compare the critical discourses of Poincaré with the "Electrical Papers" of Heaviside, we shall be impressed with the importance to the physicist and especially to the electrician of thinking in vectors, for that notation mirrors physical nature more clearly. However, there are many who do not think in vectors; to them Poincaré's discourses will be the more valuable; but he who studies both Poincaré and Heaviside will be well off, for they are, to a large extent, supplementary of one another.

A Continuous Short Circuit.

A correspondent writes us of a peculiar case of short circuiting which recently occurred on one of the circuits of an electric lighting company. The fuses in the station were blown just after a violent stroke of lightning, and the superintendent upon testing found that there was a dead short circuit. After examining a number of converters it was found that the lightning had entered one of these, passed to one of the countersunk screws in the porcelain fuse block, and through the cement with which the counter-bore was plugged to the casing of the converter, and the arc thus established had fused the screw head to the iron casing of the block, causing the short circuit. The primary fuses were not blown.

Neutralizing Hysteresis.

According to some recent experiments it was found that if an alternating current be passed through iron, presumably in the direction of the lines of force, the hysteresis cycle was made to disappear completely. It has been suggested that, if this is so, and if the energy of this current is not greater than that absorbed by the hysteresis, it might be possible to apply this to advantage in transformers.

British Association Meeting at Oxford.

By Cable from The Electrical World's Special Correspondent.

The meeting of the British Association at Oxford, which has long been looked forward to as one of the most interesting of the many important gatherings held by that society, opened on Wednesday last, under most auspicious circumstances. The attendance was excellent, including Prof. George W. Barker, of the University of Pennsylvania, Philadelphia, Prof. Langley, of Washington, and Prof. Mayer, of the Stevens Institute, Hoboken, besides many other distinguished strangers. Lord Kelvin, Lord Rayleigh, Profs. A. W. B. Kennedy, O. J. Lodge, S. P. Thompson and many other men whose names are well known to the American electrical public, were present.

The president of the association, the Marquis of Salisbury, delivered an address, which was well received. The address of Prof. Rucker president of Section A, related to the interest which now exists in the systematic abstracting and cataloguing of physical papers and the course with regard to this work which the Physical Society of London propose to take. Prof. A. B. W. Kennedy, president of Section G, spoke on "Modern Mechanical Training, Constructive and Critical." The address of both Profs. Rucker and Kennedy incidentally touched upon electricity.

The electrical papers were numerous. Considerable interest was excited on Wednesday by Lord Kelvin and Prof. Lodge. On Thursday Mr. Hiram Maxim discussed the result of his recent experiments with his flying machine, claiming that lifting itself it would maintain a speed of fifty miles an hour for thirteen hours. This proved to be an interesting topic, and Lord Rayleigh described his trip on the machine, speaking of it as one of the sensations of his life. He complimented Mr. Maxim cordially on the results attained. Prof. Langley expressed his admiration of the invention, but questioned its commercial advantage on account of the risk to human life. Lord Kelvin expressed his appreciation of Maxim's work but suggested the use of platforms instead of aëreoplanes.

Monday (to-day) was the electrical engineers field day. The principal papers were read by Mr. W. H. Preece, who took up the problem of signaling without wires, a subject which he discussed last year at the International Congress of Electricians, at Chicago; by Prof. Silvanus P. Thomson, who championed alternating currents; and by Mr. T. Parker, who advocated, high voltage continuous currents, describing the continuous current transformer system at Oxford.

The weather during the meetings has been moderately fair.

Oxford, England, August 13, 1894.

The American Association for the Advancement of Science.

The forty-third meeting of the American Association for the Advancement of Science and the meetings of the affiliated societies will open in Brooklyn this week. The session of the society proper commences on Wednesday, August 15, with the regular meeting of the Council; but the meetings of a number of the other scientific societies begin on Monday, August 13. The following are the names of the sections, their presiding officers and places of meeting:

Section A—Mathematics and Astronomy, Geo. C. Comstock, Madison, Wis.; rooms 22 and 23, Polytechnic Institute. Section B—Physics, William A. Rogers, Waterville, Me.; room 30, third floor, Polytechnic Institute. Section C—Chemistry.; Thos. H. Norton, Cincinnati, O.; chemical lecture room, fourth floor, Polytechnic Institute. Section D—Mechanical Science and Engineering, Mansfield Merriam, South Bethlehem, Pa.; room 33, third floor, Polytechnic Institute. Section E—Geology and Geography, Samuel Calvin, Iowa City, Ia.; room 7, first floor, Packer Institute. Section F—Zoology, room 21, third floor, Packer Institute. Section G—Botany, Lucien M. Underwood, Greencastle, Ind.; room 5, first floor, Packer Institute. Section H—Anthropology, Franz Boas, New York; New Chapel, first floor, Polytechnic Institute. Section I—Henry Farquhar, Washington, D. C.; Large Hall, first floor Polytechnic Institute.

Only a general programme of the meetings can as yet be given, as the papers to be read each day before the different sections will not be known until the day before. The following is the programme so far as known:

THURSDAY, AUGUST 16.

AFTERNOON.

Addresses of the vice-presidents in halls as follows: At half-past two o'clock, in room 33, third floor, Polytechnic Institute, Vice President Rogers, before Section of Physics; subject: "Obscure Heat as an Agent in Producing Expansion and Contraction in Metals." In New Chapel, first floor, Polytechnic Institute, VicePresident Boas, before section of Anthropology; subject: "Human Faculty as Determined by Race." In large hall, first floor, Polytechnic Institute, Vice-President Calvin, before Section of Geology and Geography; subject: "Some Points in Geological History Illustrated in Northeastern Iowa." At half-past three o'clock, in hall, first floor, Polytechnic Institute, Vice-President Farquhar, before Section of Economic Science and Statistics; subject: "A Stable Monetary Standard." In room 33, third floor, Polytechnic Institute, Vice-President Comstock, before Section of Mathematics and Astronomy: subject: "Binary Stars." At half-past four o'clock, large hall, first floor, Polytechnic Institute, Vice-President Underwood, before Section of Botany; subject: "The Evolution of the Hepaticæ." Room 33, third floor, Polytechnic Institute. Vice-President Norton, before Section of Chemistry; subject: "The Battle with Fire." New Chapel, first floor, Polytechnic Institute, Vice-President Merriman, before Section of Mechanical Science and Engineering; subject: "Paradoxes in the Resistance of Materials."

EVENING.

General session in the Academy of Music, at 8 o'clock.

Address of the retiring President, Dr. William Harkness, of Washington, followed by a reception in the Assembly Rooms and Art Galleries, given by the Ladies' Reception Committee of Brooklyn. Buffet lunch following the reception.

FRIDAY, AUGUST 17.

MORNING.

Meeting of the council at 9 o'clock, room 4, Polytechnic Institute. General session at 10 o'clock.

Meetings of the sections in their several halls after adjournment of the general session.

(The daily programme will give the titles of papers to be read in each section.) By votes passed at the last meeting, Sections F and G will hold a joint session during this day for the reading of papers of interest to members of both sections.

AFTERNOON.

Meetings of the sections at 2 o'clock.

EVENING.

Public lecture, complimentary to the citizens of Brooklyn. (The name of the speaker and the subject to be announced.)

SATURDAY, AUGUST 18.

The day will be given up to excursions, to be announced in the daily programme.

MONDAY, AUGUST 20.

MORNING.

Meeting of the Council at 9 o'clock. General session at 10 o'clock. Meetings of the sections after general session.

AFTERNOON.

Meetings of the sections at 2 o'clock.

EVENING.

Address on a scientific subject of general interest. Speaker to be announced.

TUESDAY, AUGUST 21.

MORNING.

Meeting of the council at 9 o'clock. General session at 10 o'clock. Meetings of the sections after general session.

AFTERNOON.

Meetings of the sections at 2 o'clock.

EVENING.

Public lecture, complimentary to citizens of Brooklyn, by Dr. B. J. Fernow, of Washington, on "The Battle of the Forest," illustrated with lantern photographs. Meeting of the Nominating Committee in room 4, Polytechnic Institute, at 9 o'clock.

WEDNESDAY, AUGUST 22.

MORNING.

Meeting of the council at 9 o'clock. General session at 10 o'clock. Election of officers and agreement on place of meeting for 1895. Meetings of the sections after general sessions.

AFTERNOON.

Meetings of the sections at 2 o'clock.

EVENING.

General session in the Art Association Hall, Montague street, at 8 o'clock. Concluding exercises and adjournment of the association.

Of the affiliated societies only two are of special interest to the electrical public, The American Mathematical Society and the Society for the Promotion of Engineering Education. The former will meet in room 34 on the third floor of the Polytechnic Institute on Monday, Tuesday, and Wednesday, August 13, 14, and 15. Dr. Emory McClintoch, of New York, is president. The Society for the Promotion of Engineering Education, of which Prof. De Volson Wood is president, will meet in room 20, second floor, Polytechnic Institute, August 20, 23. The following is the provisional programme, except that portion devoted solely to civil engineering:

BEFORE THE WHOLE SOCIETY.

1. Entrance Requirements Common to all Engineering Schools, F. O. Marvin, Kansas State University.
2. Engineering Education and the State University, Wm. S. Aldrich, University of West Virginia.
3. Specializing in Engineering Education, Robt. Fletcher, Thayer School of Civ. Eng.
4. Text Books Considered as Such and Not as Works of Reference, C. H. Benjamin, Case School of Applied Sciences.
5. Graduate and Post-Graduate Engineering Degrees, Palmer C. Ricketts, Rensselaer Polytechnic Institute; Geo. F. Swain, Mass. Inst. Technology; Robt. H. Thurston, Director of Sibley College, Cornell University.
6. Comparative Value of Graduate Study in Engineering, Wm. H. Burr, Columbia College School of Mines.
7. Teachers and Text Books in Mathematics for Engineering Students, Mansfield Merriman, Lehigh University.
8. Teaching Engineering Specifications and the Law of Contracts, J. B. Johnson, Washington University.
9. Teaching Mechanical Drawing and Lettering in Engineering Schools, J. J. Flather, Purdue University.
10. Early Instruction in Physics and Mechanics, C. M. Woodward, Dean of School of Engineering, Washington University.
11. Engineering Courses as a Preparation for Manufacturing and Commercial Life.
12. Some German Schools of Engineering, Storm Bull, University of Wisconsin.
13. The Organization and Conduct of Engineering Laboratories and the Equipment of the Laboratories at the Mass. Inst. Tech., Gaetano Lanza.

BEFORE THE MECHANICAL AND ELECTRICAL ENGINEERING SECTION.

1. Mechanical Laboratory Equipment, R. C. Carpenter, Cornell University.
2. Mechanical Laboratory Work at Ames, Ia., G. W. Bissel, Iowa Agricultural College.
3. Amount and Kind of Shop Work Required in a Mechanical Engineering Course, C. W. Marx, University of Missouri.
4. Electrical Engineering Laboratories, D. C. Jackson, University of Wisconsin.
5. Teaching Industrial Applications of Electricity.
6. Teaching Machine Design.
7. Seminary Work in Mechanical Engineering at the University of Michigan, M. E. Cooley, University of Michigan.

American Association for the Advancement of Science.

BY WILLIAM HENRY HALE.

In this age of multitudinous associations of all kinds, there are but few which challenge special attention above others. The American Association for the Advancement of Science, however, still retains the position which it has held for nearly half a century, of the great general convocation of scientists of America, and of all who are interested in science in any department. Not for specialists in any one branch of science exclusively, nor even restricted in its membership to scientists, its aim and scope are broad enough for all who care to learn as well as for all who have the skill to teach.

This association is a reorganization of the American Association of Geologists and Naturalists, which was formed at Philadelphia in 1840 with Edward Hitchcock as president. The date of the organization under the present name was 1848, and the place was again Philadelphia. The first president was W. C. Redfield. Among the founders were the foremost scientists of the age, Agassiz, the Baches, the Becks, Dana, Gray, Guyot, James Hall, Joseph Henry, Le Conte, Loomis, Olmsted, Peirce, the Sillimans, Torrey; but then, as now, its membership was not restricted to scientists, and such names as William H. Seward and John V. L. Pruyn were also on the roll. Of the founders of the association, the survivors still on the membership list are only Thomas T. Bouve, of Boston; James D. Dana, of Yale; Traill Green, of Easton, Pa.; James Hall, of Albany, and J. H. Redfield, of Philadelphia. Dr. Charles E. West, of Brooklyn, was also on original member, but allowed his membership to lapse. Of these six surviving founders, two, Dana and Hall, have been presidents of the association.

Of the earlier meetings, that at Albany in 1856 was by far the most important, bringing together the largest and most impressive gathering of scientists which had yet been held in America, for the purpose of dedicating the Dudley Observatory. I well remember listening, as an academy boy, to the immortal oration of Edward Everett, delivered in the tent in the park of the Albany Academy.

The war smote harshly on our association, and no meetings were held from 1860 till 1866, when the association was again reformed at Buffalo, and started on its successful career of annual meetings, which have been held in August ever since that time, except in 1884, when a September meeting was held at Philadelphia in connection with the British Association. Thus, on three occasions, Philadelphia is conspicuous in the history of the association. The last Philadelphia meeting is notable as the largest ever held.

The Buffalo meeting was regarded as marking such an important epoch that decennial meetings have been held there in 1876 and 1886. No other city has ever had more than two meetings of the association, unless the meeting in 1840 at Philadelphia be regarded as substantially an association meeting.

Another important step was taken in 1874, when the association was incorporated by the State of Massachusetts, and at the Hartford meeting the distinction was made between members and fellows, the latter class being composed of persons who devote their lives to science, or who by their labors have advanced the cause of science. As it is regarded a high honor to become a fellow, this gives the association a body of permanent supporters. Of the 154 original fellows, about one hundred still survive and appear on the roll after the lapse of twenty years, and the whole number of fellows is now nearly eight hundred.

A new era in the numbers present at the meetings date from the Boston meeting in 1880, which was attended by nearly three times as many members as any previous meeting, and since then the attendance has seldom fallen so low as before. This result was achieved by special effort of the local membership committee, and a similar one is sought by the committees of the Brooklyn meeting this summer, and was an object sought in organizing the resident members committee. There have been held, prior to this year, forty-two meetings in different places, from Portland, Me., to Minneapolis, and from Montreal to Charleston. All the largest cities have been visited, including, besides those already named, Cincinnati, Cleveland, Washington, Baltimore, Chicago, Indianapolis, Detroit, St. Louis, New York and Toronto. The forty-third meeting will be held this year at Brooklyn, and that of next year undoubtedly at San Francisco.

For several years past a number of affiliated societies have held meetings at the place appointed for that of the association, and just before the time for the latter, and in some cases simultaneously with it. These have become more numerous this year than ever before, and include the Geological Society of America, Society for the Promotion of Agricultural Science, Association of Economic Entomologists, Association of State Weather Services, Society for Promoting Engineering Education, American Microscopical Society, American Chemical Society, American Forestry Association, American Mathematical Society, besides the botanical and entomological clubs of the association. At most, if not all, of these, technical papers of great value are presented. The association is organized in nine sections: A, astronomy and mathematics; B, physics; C, chemistry; D, mechanical science and engineering; E, geology and geography; F, zoology; G, botany; H, anthropology; I, economic science and statistics. At each meeting an address is read by the retiring president, who thus has two years for preparation. Addresses by the vice-presidents of the nine sections are also read on the opening day of the session. The remaining days are occupied by the reading of papers in the several sections. Several hundred are usually presented at each meeting. Excursions and receptions give an agreeable variety to the exercises, and afford abundant opportunity to form and renew acquaintances of the most agreeable description. This feature of association life has not escaped criticism, but it is in reality one of the most useful in securing free interchange of opinions, as well as an amount of relaxation which the inclement heat of August enforces.

The general plan of the American Association resembles that of others in foreign lands, the British, the French and the Australasian. In numbers, our own association lags far behind the

British, as well as behind many societies of specialists, such, for instance, as electricians. It has long seemed to some of us that this ought to be so, and that if the aim and scope of the meetings and their many delightful accessories were thoroughly understood, that a great influx of new members would ensue, and would place our association on the same plane as the British in popularity and consequent usefulness. Such has been one of the ends sought by holding a meeting in Brooklyn, with its magnificent equipment of colleges and technical schools, such as the Polytechnic, Pratt, Packer, Adelphi, Long Island Medical College, Hoagland Laboratory, and several Roman Catholic colleges and seminaries. Chief of all, the Brooklyn Institute, with its numerous departments and comprehensive scheme of lectures and meetings, with land already set apart for a new building, and plans for the building completed, is regarded as the most important auxiliary to the Brooklyn meeting.

The reception and entertainments of the association are always cared for by a local committee. The committee for this year includes several hundred of the prominent citizens of Brooklyn and vicinity, under the presidency of Mayor Schieren, and is by far the most brilliant as well as the largest ever organized. Nor is the mayor a mere figurehead, but he has shown profound interest in the success of the movement. Among the vice-presidents are J. S. T. Stranahan, usually designated "the first citizen of Brooklyn;" Gen. O. O. Howard, as head of the army, and Admiral Bancroft Gherardi, as head of the navy, in this part of the United States; Benjamin D. Silliman, one of the three oldest surviving graduates of Yale; Father Malone, recently elected one of the regents of the University of the State of New York; the Roman Catholic bishop, C. E. McDonnell, and Rev. Dr. Richard S. Storrs, Prof. Charles E. West, above mentioned, and the presidents of the leading professional and literary institutions of the city. Besides the local committee and included in it are several sub-committees, which have each been placed under the chairmanship of some member of the Brooklyn Institute. The resident members of the association have this year organized a committee to enhance the success of the meeting. This is entirely independent of the local committee, though, in fact, most of the resident members are connected with both. The association comes to Brooklyn at the most memorable crisis of its history.

By a popular uprising among the grandest in all history, the city has just redeemed itself from galling and oppressive servitude and spoliation. It has doubled its area, and ranks as a city of a million people. As a part in all but political union of the metropolis of the western world, it presents unrivalled attractions to its distinguished guests; and yet, from its subordinate relation to its greater neighbor, it has never been very much a city of conventions. No such distinguished gathering has ever before been assembled there. The writer, as a Brooklynite, but echoes the sentiment of his fellow citizens in expressing the hope that the interest and importance of the Brooklyn meeting may render this an epoch more brilliant than the brightest which mark the names of Albany, Buffalo, Boston or Philadelphia.

A Graphical Transformer.*

BY A. P. TROTTER.

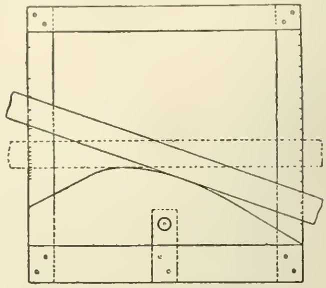
This instrument is intended for the expeditious re-plotting of a curve with transformed ordinates without calculation or scaling. It consists of a rectangular frame and a curved template or cam, and is used in conjunction with a straight ruler.

Let the scale of one system of ordinates be set off upwards along the edge of one of the perpendiculars, and the scale of the other along the edge of the other perpendicular, but downwards. Join the corresponding points on the scale by straight lines. The envelope of this system of lines may be thus drawn, and to this curve a cam is cut in thin wood or ebonite.

To transform any ordinate, set the frame against a T-square, adjusting the edge to the ordinate, and the zero to the zero of the scale. Set a needle at the extremity of the ordinate; bring a straight edge to touch the needle and the cam; prick off a point at the intersection of the straight edge with the other edge of the frame. This point determines the length of the new ordinate.

The illustration represents an instrument provided with a logarithmic cam. With this instrument the product or quotient of two curves can be found by adding or subtracting the logarithms of the ordinates; or the logarithms of a series of observations can be plotted. Cams for other functions can be easily made; but it must be remembered that the action of the instrument is, as it were, arithmetical rather than geometrical, for a cam is useful only with reference to its own scale.

This instrument not only enables transformations of a definite and known character to be made, but is equally applicable for transforming in an empirical manner. The curve drawn by a recording voltmeter or ammeter may thus be re-plotted for estimation of area,



A GRAPHICAL TRANSFORMER.

or other graphical analysis, without any knowledge of the law of the particular instrument. In other words, a correction can be applied to a curve.

The cams are easy to make, and even if carelessly cut cannot possibly give rise to cumulative errors. It is convenient to use the upper edge of the ruler instead of the edge which rolls on the cam. The curve must in this case be set out with the ruler, and used with the same ruler or one of the same width. The rolling of a straight edge on a cam has been used in a photometer, invented by Mr. W. H. Preece and the author,† for the automatic calculation of the squares of the displacements of a lamp.

*A paper read before the Oxford Meeting of the British Association.

† Proc. Inst. Civ. Eng. Tol. C. Xp. 81.

Electric Lighting in Great Britain—II.

BY E. RAY STEVENS.

As yet it is almost too early to draw any general conclusions as to the financial success of the electric lighting plants of Great Britain, for but few of the plants have been in operation long enough to judge fairly of their ultimate success. With rare exceptions the operation of all the plants has been begun in the last decade, and that of most of them since 1890.

According to the return made by the Board of Trade to Parliament, but a few days since, there are in the United Kingdom about one hundred plants, only a part of which are as yet actually in operation. But beside these there are a few that did not secure provisional orders from the Board, and hence are not reported by them, nor are they under the rather strict regulations noted in the first part of this paper. They have no parliamentary sanction, and do not, one might say, have any legal existence. But there are not many of these plants, as most companies prefer to secure parliamentary sanction for their undertakings.

The number of plants is now increasing more rapidly. Last year the Board of Trade granted provisional orders to municipal authorities in fifteen cases, and also to nine companies. The pages of electrical journals are crowded each week with notices of cities in which the establishment of a plant is being considered. A recent number of one of the journals, picked up at random, noted fifteen local authorities that were discussing the establishment of a plant of their own, and also eight cities where private companies had decided to put in a plant if the provisional order could be obtained. More plants have been established under provisional orders by local authorities than by companies. This is in accordance with the general tendency of English municipal governments to assume extended functions, especially when dealing with the supply of water, light and intramural transportation. There are forty-nine public and forty-six private electric light plants in the kingdom operated or established under provisional orders. But, on the other hand, all of the seven plants operated under license from the Board of Trade are in the hands of companies.

LONDON, ENG.

(To be continued.)

Successful Rivalry.

Our London contemporary "Electricity" entitles as a "victory of electricity over gas" a recent occurrence in Indiana, in which four gas wells were struck by lightning and destroyed.

Dynamo Electric Machinery—III.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

(c.) *Self-exciting* machines, or generators whose field magnets are supplied by currents from the armature.

Fig. 5 represents a form of self-excited generator. M, M, are the field magnets, P the pilot lamp, S the main circuit switch, R the rocker-arm carrying the bushes B, B.

12. Self-excited machines may be divided into three classes, viz.:

(1.) Series wound.

(2.) Shunt wound.

(3.) Compound wound.

Series-wound machines have their field magnets connected in series with their armatures. The field winding consists, therefore, of stout wire, in comparatively few turns. Arc light machines are

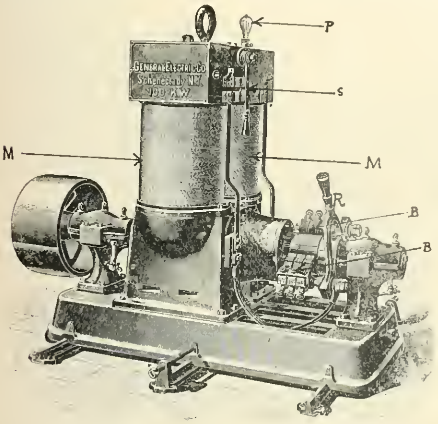


Fig. 5.—Self-Excited Continuous Current Generator.

almost always series wound. Fig. 6 represents a particular form of series wound machine for arc light circuits. Here the current from the armature passes round the cylindrical magnets, M, M, through the regulating magnet, m, and thence to the external circuit. The machine in Fig. 2 is also series wound.

Shunt-wound machines have their field magnets connected to the main terminals, that is, in shunt with the external circuit. In order to employ only a small fraction of the total current from the armature for this purpose, the resistance of the field magnets is made many times higher than the resistance of the external circuit.

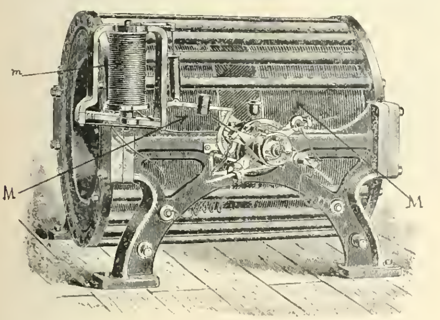


Fig. 6.—Self-Excited Series Wound Continuous Current Generator.

This is accomplished by winding the magnets with many turns of fine wire, carefully insulated.

A particular form of shunt-wound machine is represented in Fig. 7.

Here the fine wire windings of the four magnet coils are supplied in one series through the connecting wires W, W, W, from the main terminals of the machine, one of which is shown at M. In order to regulate the strength of the exciting current through the magnets circuit, it is usual to insert a hand regulating resistance box, called the *field regulating box*, in series with them.

Compound-wound machines. These are machines that are partly shunt wound and partly series wound.

It is found that when the load increases on a series-wound generator, it tends to increase the pressure at its terminals, i.e., to raise its E.M.F. On the other hand, when the load increases on a shunt-wound generator, it tends to diminish the pressure at its terminals, i. e., to lower its E.M.F. In order, therefore, to obtain good *automatic* regulation of pressure from a machine under all loads, these two tendencies are so united as to cancel each

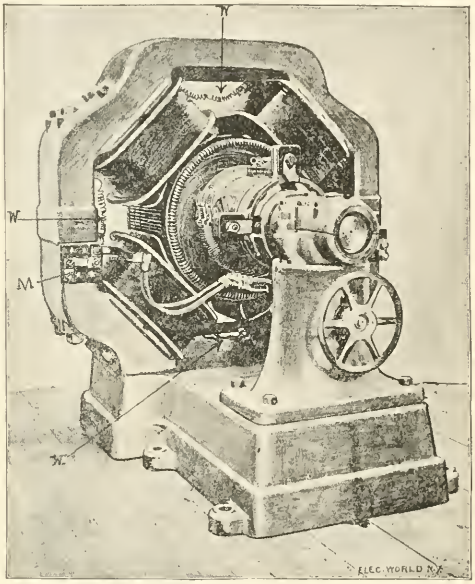


Fig. 7.—Self-Excited Shunt Wound Continuous Current Generator.

other by employing a winding that is partly shunt and partly series.

Fig. 8 represents a particular form of compound-wound machine. Here there are two spools side by side on each magnet-core, one of fine wire in the shunt circuit, carrying a current, and exciting the fields, even when no current is supplied externally by the machine. The other spool is of stout conductor making compara-

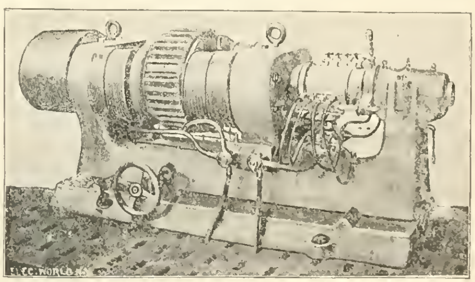


Fig. 8.—Compound Wound Continuous Current Generator.

tively few turns. This is part of the series winding which carries the current to the external circuit. The excitation of the magnets from this winding, therefore, depends upon the current delivered by the machine; i. e., upon its load.

Many generators for incandescent lamp circuits, also many generators for power circuits are compound wound.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

A Sign of Progress.

It is certainly a sign of progress when an inventor, in describing his primary battery in a recent issue of a journal, admits that the

cost of the current thus obtained will be greater than that obtained from dynamos.

Electrical Sanitation.

Mr. C. W. Chancellor, U. S. Consul at Havre, France, has submitted to the Department of State an interesting report on the results of the experiments with the Hermite process at Havre, from which the following extracts may prove of interest:

This so-called system is based on the electrolysis of sea water. The electric current is used to decompose the chloride of magnesium, while the chloride of sodium serves as a conductor. The result is a liquid disinfectant of great power, which is almost odorless, leaves no residuum when used for purposes of flushing, and is said to be inoffensive. It is further claimed that the solid organic matters in sewage are consumed or dissolved in this liquid, leaving an odorless fluid, incapable of fermentation, and containing only a few phosphates, the salts of ammonia, and the salts of the disinfectant. The action of the liquid on germ life is peculiar. In an address delivered at the Hotel de Ville, Havre, on the sanitation of the city, M. André Dubosc, the eminent savant, gave a very clear explanation of the way in which microbes are destroyed by the Hermite liquid. He said:

"Microbes may be divided into two great classes—anaërobic organisms, which exist without air, and aërobic organisms, requiring air to live. On the anaërobes, or microbes, living without air, the action of the compound of chlorine is simple, as the freeing of its oxygen causes their instant death, inasmuch as in presence of that gas in excess, as their name indicates, they cannot exist. With regard to the aërobes, their death is brought about by chemical means. The fatty principles, particularly abundant in sewage matters, are specially concerned; the oxygen is absorbed, the volatile fatty acids liberated, and these undergo so strong an oxidation that they often result in the appearance of formic acid. The equilibrium of the chemical medium of the microbe being thus destroyed, it perishes as an individual would perish after swallowing vitriol or inhaling sulphurous acid gas."

Other experts who have looked into the system, while admitting the disinfecting properties of the electrolyzed sea water, or mixture of sodium and chloride of magnesium, have expressed some doubts as to whether the liquid could be produced in sufficient abundance, and at a sufficiently cheap rate for large towns, including the sewers and streets to be irrigated with it. But the experiments at Havre, where there is an unlimited supply of sea water, have demonstrated quite the contrary, so far, at least, as quantity is concerned; but there is not a unanimous consensus of opinion on the question of economy. It may be safely said, however, that the application of the system would have the advantage of saving a large proportion of the water usually employed for the flushing of soil pipes and drain pipes, as well as the much larger quantity employed in flushing sewers and washing gutters. How far this would compensate for the expense of the plant, etc., must, of course, depend upon the value and quantity of water ordinarily used.

Although sea water renders the application of the Hermite method considerably cheaper, it is not essential to it. When sea water is not procurable, a solution of chloride of magnesium can be used instead. Here a parallel chemical action is produced, giving precisely similar results. In every instance a central station has to be constructed and supplied with the necessary electric plant and convenient tanks, in which the disinfectant is prepared in sufficient quantities. By a simple arrangement of pipes the electrolyzed water is distributed through the streets, like the water for domestic use or like gas. It can also be conveyed into houses, and the contents of water closets, after being treated with the disinfectant, will help to purify the main drains and sewers instead of adding to their general contamination. The hygienic character of dwellings, so far as the absence of sewer gas is concerned, would obviously be greatly increased by this means, since there would be none of this deadly gas to escape through defective pipes and traps, and it has, moreover, been demonstrated by French bacteriologists that all these microscopic forms of life which "live and move and have their being"' in sewage, and which wage a constant war upon the human race, will rapidly perish in the electrolyzed solution.

The report of a scientific and technical commission, composed of eminent sanitarians, chemists and engineers, appointed by the municipal council of Havre to investigate the Hermite system, has just been given publicity. This commission, after prolonged experiments made at Havre on an elaborate scale, have formulated the following conclusions: (1) That electrolyzed sea water is a powerful antiseptic and germicide. (2) That the activity of the agent is in proportion to the quantity of chlorine; that is to say, an equal weight of chlorine acts more energetically and efficaciously in ten litres of water than in twenty litres, and in five litres than in ten. (3) That the disinfecting action of the liquid is not instantaneous, but continuous, as long as there is an excess of chlorine remaining. (4) That five grams of active chlorine will, with sufficient time, completely disinfect the excreta of a normal "stool" or dejection, and after two hours of contact all pathogenic germs will be destroyed and disappear.

The commission do not hesitate to declare the great value of M. Hermite's process of sanitation by electrolyzed sea water under the following conditions: (1) That to act efficiently on the material to be disinfected, the electrolyzed water must be in sufficient quantity, and contain a minimum of 0.5 gram of free chlorine per litre. (2) That the excreta must be kept in contact with the liquid, in the syphon of the closet or other receptacle a sufficient length of time to insure the antiseptic action of the liquid before being discharged into the gutter or sewer.

From a financial point of view, the commission declares that the results obtained during the experiments with the Hermite system in the quarter of St. François at Havre show that while the system gave excellent results from a sanitary standpoint, it cannot be considered an economical system, but requires further study and improvement before it can be recommended as applicable to large cities. Some doubt, moreover, is expressed as to whether a chlorine liquid of the kind can be applied freely to dwellings without producing disagreeable, if not unwholesome effects, and without destructive corrosion of metal pipes. The chlorine gas, it is believed, will pervade the house to a greater or less extent, imparting its disagreeable odor to articles of food with which it may come in contact, and irritating the lungs of the occupants of the dwelling.

Test of a Closed Coil Arc Dynamo.*

BY R. B. OWENS AND C. A. SKINNER.

That so much has been said and written concerning the design of constant potential machinery, effects of armature reactions, control of sparking, etc., and so little concerning the machinery used for arc lighting, seems rather remarkable considering the fact that by far the larger part of our outside lighting as well as much inside lighting is done by means of arc lamps in series, and I hope a discussion will follow in which more light will be thrown on the principles of design of arc machinery, for at present there seems to be much empiricism in the matter.

The immediate object of the present paper is to show something of the nature of the armature reactions which occur in arc light machines of the closed-coil type, maintaining constant current by

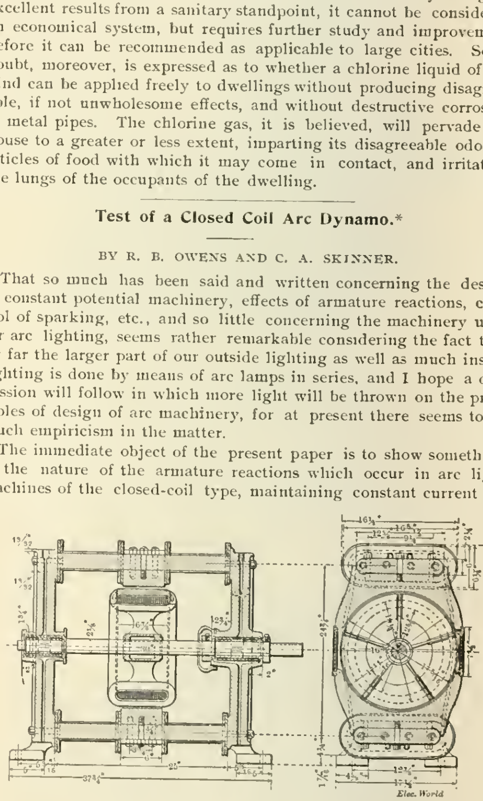


Fig. 1.—Sectional View of Dynamo.

automatically shifting the brushes to correspond with changes in load in the external circuit, and to point out certain alterations in design which it is believed may be adopted with advantage. Incidentally other points will be noted. Of course there are other well-known methods of maintaining the current constant: notably by shunting the field magnets as in the Brush machine, or a combination of this with shifting the brushes as in the new Excelsior machine, or by varying the length of time per revolution during which the armature coils are in series and shunt to each other or short circuited as in the T.-H. machine; but these will not be considered at present. Nor is it intended here to discuss the relative advantages of the several types, but only to give some results obtained in a test of a closed coil machine regulating as above mentioned. Such machines are now taking a prominent part in the arc lighting industry, and their prominence merits for them more close study. Alternating current dynamos, as the Westinghouse arc light

* A paper read at the Philadelphia meeting of the American Institute of Electrical Engineers.

machine, have been devised, which keep the square root of the mean square of the current remarkably constant through extremely wide variations in load and without any external regulating mechanism whatever. They possess many advantages, but are not now widely used, for arc lamps seem as yet to work more satisfactorily on continuous current circuits. We believe it is also possible to build continuous current arc machines which by armature reactions alone can keep the current very nearly constant throughout a considerable range; but it would seem that their cost would be more and their efficiency less than in some of the types using an external regulating mechanism, although we have no exact comparative data.

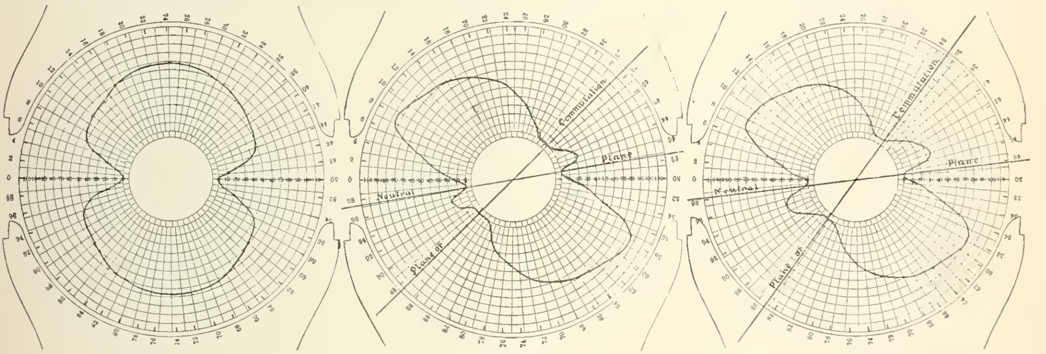
The machine on which the following experiments were made is a No. 6 25-light 2,000-c.p. Wood arc dynamo, a scale drawing of which is shown in Fig. 1.

From the drawing all dimension as of magnet limbs, yoke pole pieces, armature, etc., are at once seen, its designer, Mr. James J. Wood, most courteously consenting to my giving the name of the machine tested and its full data.

The winding data and other details as furnished by the makers are as follows:

The field magnet winding is composed of four coils of No. 10 B. & S. gauge copper wire single cotton covered. The outside diameter when insulated is 0.114 in. Each coil contain 100 lbs. of wire in 15 layers of 74 turns each.

The insulation of the magnet cores is ⅛ in. thick, and composed of one layer of enameled cloth, the enameled surface facing the



Figs. 2, 3 and 4.—Showing Distribution of E. M. F. with 10 Amperes in Field and no Current in Armature; E. M. F. with 10 Ampere Current in Field and Armature, 25 Light Position; E. M. F. with 10 Amperes in Field and Armature, 20 Light Position.

iron, the remainder being composed of pressboard 0.025 in thick. The magnet heads are wooden washers 5-16 in. thick, carefully dried and shellacked.

The armature core is composed of No. 10 B. & S. gauge annealed charcoal iron wire. This is wound on a former which is removable and is composed of 15 layers 6¾ in. wide. These wires are held together by interposed strips of linen tape. The core is then insu-

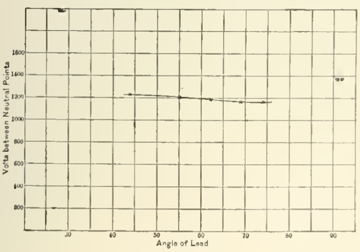


Fig. 8.

lated with a layer of asbestos paper, 3 thickness of pressboard 0.15 in. thick, one layer of asbestos paper again, and then over this one more layer of pressboard 0.15 in. thick, making a smooth surface for the copper wires to be wound on. The insulations near the spider arms are built up of the same material, and in the same manner as the armature core, until they attain a thickness of ¼ in. The armature is wound with 100 sections of No. 14 B. & S. gauge double cotton covered wire. Each section is composed of 93 feet, or 57 turns per section, making a total of 115 pounds of wire.

The regulator magnet is wound with No. 11 single cotton covered B. & S. gauge wire, in the manner shown on the dynamo, the insulation of the cores being 5-32 in. thick, and that of the magnet heads 3-16 in. Speed of dynamo, 1,000 rev. per minute.

The dynamo was securely bolted to a firm foundation of masonry, and driven through a 7 in. belt by a small 8 in. x 10 in. high-speed automatic Atlas engine making 250 revolutions per minute. Steam was supplied at as nearly constant pressure as possible. The automatic regulator of the dynamo was removed together with one pair of opposite collecting brushes, and the remaining pair reduced one-half in width parallel to the commutator bars, to allow of easier manipulation of the exploring brushes, their angular width being, of course, adjusted for each load to prevent sparking.

It was at first attempted to use a number of arc lamps as load for the dynamo, but though carefully adjusted, and using cored carbons, the variation of potential and current due to their feeding was greater than could be admitted, so the lamps were discarded for two water rheostats 4 feet × 1 foot × 1 foot, with carbon electrodes. These latter, on the whole, were found to work quite satisfactorily, their resistance hot was considerably less than when cold, but it changed so gradually that no trouble was experienced in correcting for it by adjusting the electrodes.

The distribution of the induction entering the armature at different loads was obtained by taking the E.M.F. at various points on the commutator between two small pilot brushes moved around and in contact with it.

The two brush method, though somewhat more difficult to work than the single brush method, has the advantage over the latter of giving the quantities sought directly, instead of as a difference between quantities which are large as compared with those desired. In some cases the integral readings of the brush method have been plotted, but curves so obtained do not indicate so clearly what is mainly sought, namely, the distribution of lines of force entering the armature. True, one curve can be approximately obtained from the other if electrostatic instruments are used, but not with electromagnetic instruments, for they will give only a mean E.M.F. depending on the relative width of a commutator bar and insulation and distance apart of the pilot brushes. The results obtained, however, with a voltmeter of the Weston type are proportional, and for the present purpose are equally valuable.

The exploring brushes as finally used were pieces of steel watch springs firmly held in small fibre holders. These, in turn, were rigidly secured by brass studs to a graduated sliding ring, moving within another stationary ring, attached to and insulated from the dynamo frame and carefully centred with the commutator.

Two brushes were used in each holder to better insure good contact. Copper, brass and phosphor-bronze exploring brushes were tried at first but found not as satisfactory as steel. It was also found very necessary at all times to keep the brushes and commutator as clean as possible.

The sliding ring was marked off into one hundred divisions, the number of commutator segments, and the exploring brushes made to cover just two commutator bars or one-fiftieth of the circumference, but the ring might have been divided into degrees if desired. The curves shown in Figs. 2, 3, 4, 5, 6 and 7 are plotted so that the results may be read either in degrees or in divisions of the graduated ring.

The inner circle representing the commutator of one hundred segments and the one hundred divisions of the ring are marked on the outer circle.

The radial lines are 5 degrees apart, and the radial distance between concentric circles represents 10 volts. If the results had been plotted on a developed diagram, then the areas of the curves would have represented total or integral electromotive forces, but the circular diagram has the advantage of appealing more quickly to the eye, and though the total E. M. F. is not exactly represented by the area it is proportional to the number of the small approximate rectangles enclosed. In obtaining efficiency measurements the power delivered to the dynamo was obtained by indicating the engine. The cards were taken with a Tabor indicator and worked up with a Coffin averaging instrument; the speed was obtained by a speed counter and stop watch. The electrical instruments used were a Weston 0 15 ampere meter for current measurements, a Weston 0.15 and 0.150 voltmeter for potentials between pilot brushes and a 0.150 and 0.1500 Weston voltmeter for total electromotive forces. All instruments were previously calibrated.

Fifteen sets of readings, fifty readings per set, were taken around the commutator with currents in armature and field of 8, 10 and 12 amperes, at positions of the collecting brushes approximately corresponding to loads of 5, 10, 15, 20 and 25 lights. Three sets of readings were also taken with currents in the field of 8, 10 and 12 amperes and no current in the armature. The results obtained are given in tables (not printed) and for a current of ten amperes are plotted in corresponding plates.

The reactions of the armature are so clearly shown by the curves that comment hardly seems necessary. Briefly, we see that the total induction in armature varies very slightly with lead and the displacement of the neutral plane decreases with lead angle, but varies less than 10 degrees from no load to the maximum load used.

All electromotive forces on one side of the neutral plane are of the same sign, but differ in sign from those on the opposite side.

On a developed diagram the electromotive forces between collecting brushes would be proportional to the difference between the whole area of curve on one side of the line of commutation and the area of the curve included in the angle of lead, the lead angle being defined as the angular advance of the collecting brushes from the neutral plane. An inspection of the curve of total E.M.F. with angle of lead given in Fig. 6 shows that the E. M. F. between neutral points remains nearly constant as lead varies, which it is believed would not be the case if contracted polar faces were used instead of the extended ones as shown, for then the shifting of the field could not be so easily effected. Of course a machine of the design tested with extended pole tips requires an automatic widening of the brush with increased load or independent control of sparking, but it would seem that the waste field at all loads would be less and its weight efficiency greater or cost for a given ouptut less than if its pole tips were cut away. Cutting away the pole tips or at least not extending them would have the advantage of allowing the use of collecting brushes of constant width within a certain range, but whether this advantage more than compensates for the decreased range of its output is open to question. Further experimental evidence is however needed in this regard.

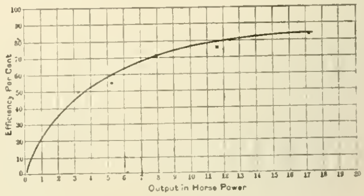
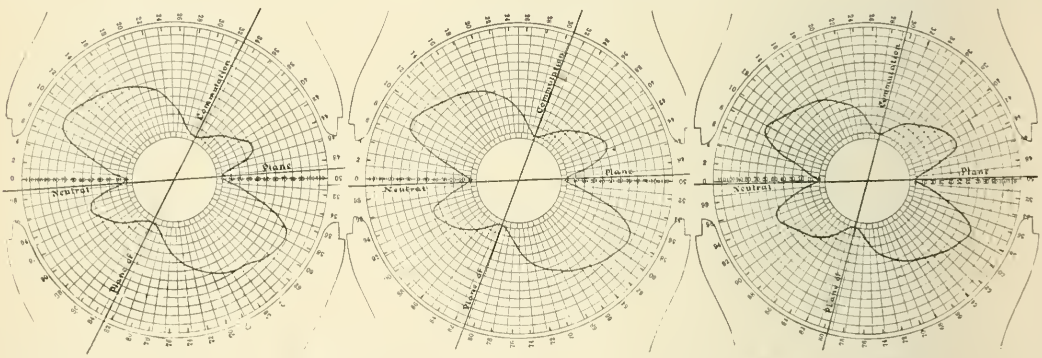


FIG. 10.



FIGS. 5, 6 AND 7.—E. M. F. WITH 10 AMPERES IN FIELD AND ARMATURE, 15 LIGHT POSITION; E. M. F. WITH 10 AMPERES IN FIELD AND ARMATURE, 10 LIGHT POSITION; E. M. F. WITH 10 AMPERES IN FIELD AND ARMATURE, 5 LIGHT POSITION.

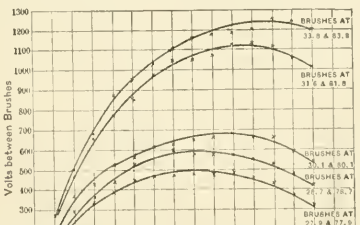


FIG. 9.

Regarding the relative amounts of iron in field and armature, we see no reason for the present practice of using so little iron in the armature, as compared with the field. The necessity of a very high field induction or a thoroughly stiff field is apparent; but why when the lines are once generated by the field it is not sought to collect and utilize them all by means of an armature with a generous amount of iron is not so easily seen. The number of commutator segments would, of course, have to be increased to prevent sparking, but the regulating qualities of the machine would, it is believed, not be impaired. The results would be a larger output and greater efficiency.

Regarding the ratio of ampere turns on field and armature, such ratio will depend largely on the shape of the pole pieces and desired width of brush, but is in all cases much less than in constant potential machines.

The characteristic curves shown in Fig. 9 were taken at the 5, 10, 15, 20 and 25 light positions of the brushes, and show that with this machine regulation is almost entirely effected by shifting the brushes, as the curves droop too slowly to assist to any material exte it. Of course, they might have been made to droop much more rapidly if the collecting brushes had been moved into sparkless positions for each value of the current, but a curve so obtained is not at all a characteristic. The efficiency curve is given on Fig. 10. From this curve, and from what we have seen of the machine, it is evident that it would never pay to run machines of this type underloaded. If a number are used in one station the connections of the external circuits at the switchboard should be so manipulated as to keep the machines actually in use always loaded to as near their full capacity as possible.

Our thanks are due to Mr. H. J. Podlesak, who greatly assisted in taking the observations and working up the results.

Practical Notes on Dynamo Calculation.—XIV.

BY ALFRED E. WIENER.

30.—*Mechanical Calculations about Armature.*

a. Shaft.

The length of the armature shaft varies considerably for the different arrangements of the field magnet frame, and, owing to the length of the commutator, in equal output dynamos of the same design depends upon the voltage; and, therefore, a general rule for the length of the shaft cannot be given.

Its diameter, however, directly depends only upon the output and the speed of the dynamo, and can be expressed as a function of these quantities, different functions, however, being employed for various portions of its length. For, while in the bearing portions, d_b, Fig. 43, torsional strength only has to be taken into account, the centre portion, d_c, Fig. 43, between the bearings,

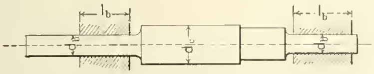


Fig. 43.

which carries the armaturecore, is to be calculated to withstand the torsional force as well as the bending due to the weight.

For steel shafts the author has found the following empirical formulæ to give good results in practice:

For bearing portions: $d_b = k_8 \times \sqrt{W} \times \sqrt[4]{N}$, (76)

where d_b = diameter of armature shaft, at bearings, in inches;

W = output of dynamo, in watts;

N = speed, in revolutions, per minute;

k_8 = constant, depending upon the kind of armature. See Table XXXVI.

The value of k_8 varies between .0025 and .005, as follows:

TABLE XXXVI.—VALUE OF CONSTANT IN FORMULA FOR JOURNAL DIAMETER OF ARMATURE SHAFT.

Kind of Armature.	Value of k_8.
High speed drum	.0025
High speed ring	.003
Slow speed drum	.004
Slow speed ring	.005

For core portion: $d_c = k_9 \times \sqrt[4]{\frac{W}{N}}$ (77)

where d_c = diameter of core portion of armature shaft, in inches;

W = output of machine, in watts;

N = speed, in revolutions, per minute;

k_9 = constant depending upon output of machine. See Table XXXVII.

This constant indicates the dependence of the diameter of the shaft upon the length between its supports; and since the weight supported and also the length supporting it increase with the output, it is evident that k_9 has a greater value the larger the output of the machine. For capacities up to 2,000 kilowatts, k_9 numerically ranges between 1 and 1.8, thus:

TABLE XXXVII.—VALUE OF CONSTANT IN FORMULA FOR DIAMETER OF CORE PORTION OF ARMATURE SHAFT.

Capacity, in Watts. W	Value of k_9.
Up to 1000 Watts	1
" 5000 "	1.1
" 10000 "	1.2
" 50000 "	1.3
" 100000 "	1.4
" 200000 "	1.5
" 500000 "	1.6
" 1000000 "	1.7
" 2000000 "	1.8

Considering the speeds given in Tables VIII., IX. and X., chapter 7, for various outputs, we obtain the following Tables XXXVIII., XXXIX. and XL., giving, respectively, the diameters of shafts for drum armatures, for high speed ring armatures, and for slow speed ring armatures:

For wrought iron shafts the diameters obtained by formulæ (76) and (77), or those taken from Tables XXXVIII., XXXIX. and XL., respectively, are to be multiplied by 1.25; that is, increased by 25 per cent.

TABLE XXXVIII.—DIAMETER OF SHAFTS FOR DRUM ARMATURES.

Capacity in Watts.	Speed in Revs. per min. (from Table VIII.)	Diameter of Armature Shaft, in inches.		
		Bearing Portion.	Core Portion.	
W.	N.	$d_b = .0025\sqrt{W} \times \sqrt[4]{N}$	k_9	$d_c = k_9 \times \sqrt[4]{\frac{W}{N}}$
100	3,000	3/16	.9	⅜
250	2 700	5/16	.95	½
500	2,400	7/16	1	⅝
1,000	2.200	9/16	1	13/16
2,000	2.000	¾	1.05	1
3,000	1,900	15/16	1.1	1¼
5,000	1,800	1⅛	1.15	1½
10,000	1,700	1⅝	1.2	2
15 000	1.600	1⅞	1 25	2¼
20,000	1,500	2⅛	1.25	2½
25,000	1,350	2⅜	1.25	2¾
30,000	1,200	2½	1.3	3
50,000	1,050	3	1.3	3½
75,000	900	3⅝	1.35	4⅛
100 000	750	4⅛	1.4	4¾
150,000	600	4¾	1.45	5¾
200,000	500	5¼	1.5	6¾
300,000	400	6	1.55	8

TABLE XXXIX.—DIAMETERS OF SHAFTS FOR HIGH SPEED RING ARMATURES.

Capacity in Watts	Speed in Revolut'ns p. min. (from Table IX.)	Diameter of Armature Shaft, in inches.		
		Bearing Portion.	Core Portion.	
W.	N.	$d_b = .003\sqrt{W} \times \sqrt[4]{N}$	k_9	$d_c = k_9 \times \sqrt[4]{\frac{W}{N}}$
100	2,600	¼	.9	⅜
250	2,400	⅜	.95	½
500	2,200	½	1	11/16
1,000	2 000	⅝	1	⅞
2,500	1,700	1	1.05	1¼
5,000	1,500	1⅜	1.1	1⅝
10,000	1.250	1¾	1.2	2
25,000	1,000	2⅝	1.25	2⅞
50,000	800	3½	1 3	3¾
100.000	600	4¾	1 4	5
200.000	500	6⅜	1 5	6¾
300,000	450	7½	1.55	7⅞
400,000	400	8½	1 55	9
600,000	350	10	1.6	10½
800,000	300	11	1 65	12
1,000,000	250	12	1 7	13½
1,500,000	225	14	1.75	15¾
2,000,000	200	16	1 8	18

TABLE XL.—DIAMETERS OF SHAFTS FOR SLOW SPEED RING ARMATURES.

Capacity in Watts.	Speed, in Revs. per minute, (from Table X).	Diameter of Armature Shaft, in inches.		
		Bearing Portion.	Core Portion.	
W.	N.	$d_b = .005\sqrt{W} \times \sqrt[4]{N}$	k_9	$d_c = k_9 \times \sqrt[4]{\frac{W}{N}}$
2,500	400	1⅛	1 05	1⅝
5,000	350	1½	1.1	2⅛
10,000	300	2	1.2	2⅝
25,000	250	3⅛	1.25	4
50,000	200	4¼	1.3	5¼
100,000	175	5¾	1.4	6⅞
200,000	150	7¾	1.5	9
300,000	125	9⅛	1.55	10¾
400,000	100	10	1.55	12¼
600,000	90	12	1.6	14½
800,000	80	13½	1.65	16½
1,000,000	75	15	1 7	18½
1,500,000	70	18	1.75	22
2,000,000	65	20	1.8	24½

b. Driving Spokes.

Ring armature cores usually are attached to the shaft either by means of spider frames or of skeleton pulleys. In both cases the driving of the conductors is effected by a number of spokes, which, respectively, form part of the spider itself, Fig. 44, or of a separate driving frame keyed to the skeleton pulley, Fig. 45.

In dimensioning these driving spokes, on the one hand sufficient mechanical strength for driving should be provided, while at the other hand, if spiral winding is to be used, not more than necessary of the inner winding circumference should be made unavailable.

For the latter reason the axial breadth of the spokes, b_s, Fig. 44 and Fig. 45, respectively, is to be made as large as the construction of the armature allows, and their thickness, h_s, calculated to give the requisite strength.

Multiplying equation (57) for the circumferential force per

armature conductor (chapter 23) by the number of effective conductors we obtain the total peripheral force of the armature:

$$F_p = f_p \times K \times \beta' = .7375 \times \frac{E \times C}{S}, \qquad (78)$$

and, allowing a factor of safety of about 4, we get:

$$F_p' = 3 \times \frac{W}{S}.$$

Dividing F_p' by the total number of spokes, we have the pull for each spoke, and this multiplied by the leverage gives the

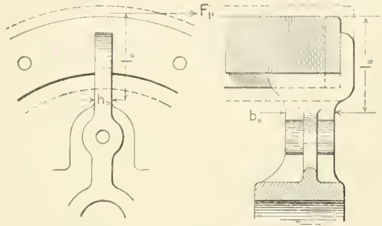


FIG. 44.

external momentum acting on each; the latter must be equal to the internal momentum, *i. e.*, the product of the modules of the

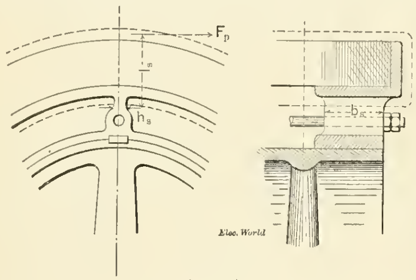


FIG. 45.

cross section and the safe working stress of the material. In consequence, we have the equation:

$$\frac{3 \times \frac{W}{S}}{n_s} \times l_s = \frac{b_s \times h_s^2}{6} \times Q,$$

or

$$b_s \times h_s^2 = 18 \times \frac{W}{S} \times \frac{l_s}{n_s \times Q}, \qquad (79)$$

in which b_s = smallest width of spoke (parallel to shaft), in inches;

h_s = smallest thickness of spoke (perpendicular to shaft), in inches;

l_s = leverage at smallest spoke section; *i.e.*, distance of smallest section from active armature conductors, in inches;

n_s = total number of spokes per amature;

W = total output of dynamo, in watts;

S = conductor velocity of armature, in feet, p. sec.;

Q = safe working load of material, in pounds per square inch;

Cast iron	Q = 5,000	lbs. p. sq. in.
Brass	= 6,000	"
Phosphor-bronze	= 7,000	"
Wrought iron	= 10,000	"
Aluminium bronze	= 12,000	"
Cast steel	= 15,000	"

For spiral windings, now, b_s, as stated above, is given by making it as large as possible, and from (79) we therefore obtain:

$$h_s = 4.25 \times \sqrt{\frac{W}{S} \times \frac{l_s}{n_s \times b_s \times Q}} \qquad (80)$$

For windings external to the core, h_s may be fixed and then b_s calculated from

$$b_s = 18 \times \frac{W}{S} \times \frac{l_s}{n_s \times h_s^2 \times Q} \qquad (81)$$

For very heavy duty dynamos a larger factor of safety should be taken, say from 6 to 8; this will change the numerical coefficient of formulæ (79) and (81) into 27 to 36, and that of equation (80) into 5.3 to 6, respectively.

(To be continued.)

Sine Forms of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—We notice in the issue of "The Electrician," of London, of July 20, Vol. XXXIII., No. 844, page 319, an editorial opinion that "the elaborate attempts which are being made by some of the American alternator builders to give this property (the sinusoidal curve of E.M.F.) to their machines are utterly useless, and a complete waste of time and energy."

It is asserted that the reasons which have induced American designers to endeavor to obtain a sinusoidal E.M.F. in their alternators are mathematical rather than practical.

This is by no means the characteristic of American electrical engineers, who are confessedly pre-eminently practical.

In point of fact the reasons, so far from being of a mathematical nature, are solely practical. It is known by observation that the loss of energy in the excitation of transformers is greater for non-sinusoidal than for sinusoidal E. M. Fs., especially at high frequencies. It is true that the extra loss of energy through non-sinusoidal E. M. F. waves is usually not of sufficient importance to render a strictly sinusoidal E. M. F. of great value for merely lighting purposes. But for purposes of power transmission, deviations from the sinusoidal form of E. M. F. wave become deleterious, partly on account of the additional drop or pressure in the conductors transmitting the energy, partly owing to the additional loss of energy entailed in the transformers, but principally owing to the reactions set up in the induction motors by the virtual harmonics present in the sinusoidal form of E. M. F. whenever rotary field motors are employed. This the practical American engineer has recognized and adopted from his already extended experience with polyphased transmission.

EDWIN J. HOUSTON,
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LABORATORY OF HOUSTON & KENNELLY, PHILADELPHIA.

To the Editor of The Electrical World:

Sir:—In your issue of August 4 you publish an article from the London Electrician on the "Sine Form of Curves of Alternating E.M.F." The writer, evidently referring to the E.M.F. of alternating dynamos, states that his opinion, which is shared by alternator experts in England, is that the elaborate attempts made by American engineers to produce sine E.M.Fs. is a complete waste of time and energy. He criticises a paper written by myself and others because it does not prove the efficacy of applying sine E.M.Fs. to motors, but as the paper does not pretend to touch this point the criticism is evidently of no value. What the paper does take up is the condition of affairs in the motor itself, more especially in the armature. But the results and conclusions may be discovered by reading it. I do object, however, to the writer saying that a generator was used which was "believed to give practically a true sine E.M.F. curve." The curve of this E.M.F. is given in the paper, and its form was not a matter of conjecture as the quotation would imply.

Curves of the *motor* E.M.Fs. (that applied to the armature, and the counter E.M.F. of the armature) were given, and the conclusion was reached that they ought to be sine curves, and usually were not.

As far as the matter in question is concerned, the statement of Mr. Scott, of the Westinghouse Company, made in the discussion of the paper referred to, is very much to the point. He instanced the case of a two phase motor, which, when driven from a certain dynamo, heated badly and had a great deal more "armature slip" than was expected. It was found on investigation that the curve of dynamo E.M.F. was irregular and the third harmonic was prominent. Being supplied with a sine E.M.F., the same motor ran efficiently and satisfactorily. Nothing can be more direct than this evidence.

Mr. Scott remarked that in such a motor the third harmonic tended to turn the armature in a direction opposite to the primary wave, the result being disastrous. Mr. Steinmetz, who champions the three phase system, pointed out that the third harmonic would tend to revolve the armature of a three phase motor in the proper direction. While this is true, the efficiency of this component would be small.

Possibly the difference of opinion which exists here and in England as to the form of E.M.F. curves is due to the fact that our manufacturers have been working for a number of years on the problem of transmitting power by rotary field motors, while in England the matter has not, apparently, been very seriously taken up. And it is only in this type of alternating current work that the question of a sine curve assumes much importance. It is undoubtedly a "complete waste of time and energy" to make elaborate attempts to

produce sine curve alternators for lighting. When the English take up seriously the transmission of power by alternating currents, then, I think, they will appreciate the value of the sine curve, and will rediscover it.

LOUIS DUNCAN.

JOHNS HOPKINS UNIVERSITY.

To the Editor of The Electrical World:

SIR:—The London Electrician, in a recent editorial, criticises quite severely our American engineers for adhering to and advocating the use of the sine curve of alternating E. M. F. for the transmission of electrical energy. It even goes so far as to express the opinion "that the elaborate attempts which have been made by some of the American alternator builders to give this property to their machines are *utterly useless* and a *complete waste* of energy." It makes light of the careful mathematical and experimental researches upon this point which have been made by our well-known engineers and experts, and it attempts to offset the wonderful progress and gratifying results which have accompanied a nearer approach to the true sine curve by the statement that it is not well thought of by English builders. Finally it declares that "we should not be surprised to hear that the sine curve should be carefully avoided and that the 'best' curve is of a very different shape," and for no apparent better reason than because it is American.

These criticisms coming from the London Electrician and entirely unsupported by any theoretical or practical evidence are even more astounding when we consider the ease with which it may be shown that the most efficient rate at which electrical force may be applied to do useful work is the sine curve, and this without the necessity of discussing *individually* the "intricate phenomena of alternating current machinery."

It is only necessary to remember that it is in virtue of the inductance or inertia of an alternating circuit that it is enabled to transform its energy into useful work, instead of dissipating it all as heat in the conductors of the circuit; just as it is in virtue of the inertia of moving bodies that mechanical energy may be transformed and utilized. Now the energy given to an electrical circuit appears at any instant both as useless heat and as the energy of inertia. The most efficient rate, then, at which an alternating E. M. F. can be applied to a circuit is that rate which will impart the greatest average momentum to the current for a given average force; just as the most efficient rate at which an alternating mechanical force can be applied to a mechanical body is that rate which will impart the greatest average momentum to the body for a given *average* force applied.

Now, while a mechanical analogy is not an essential to the proof of the electrical principle, yet as the laws of mechanics are identical with the laws of the electrical circuit, it will not be amiss to illustrate the elctrical problem by the more familiar laws of mechanics.

It is well known that the resistance and inductance of an electrical circuit correspond to the frictional resistance and inertia of a mechanical body, while the E. M. F. and current correspond to the mechanical force and velocity. Now the force (E) producing motion in overcoming inertia in a mechanical body is equal to the product of the inertia (L) and acceleration; and the acceleration is the rate of change of velocity or $\frac{di}{dt}$, where i is the velocity. Hence $E = L\frac{di}{dt}$ which is the well known electrical formula where E is the E. M. F., L is the inductance and i the current. Now assume that the force applied either varies in any manner with the time or is constant; that is, $E = f(t)$

Then we have $\quad f(t) = L\frac{di}{dt}$ or $i = \frac{1}{L}\int f(t)\,dt$

and the momentum $\quad = \int f(t)\,dt$

Now for maximum efficiency the ratio of the average momentum to the average force must be a maximum;

that is
$$\frac{\dfrac{\int_o^T \int f(t)\,dt\,.\,dt}{T}}{\dfrac{\int_o^T f(t)\,dt}{T}} = \frac{\int_o^T \int f(t)\,dt\,.\,dt}{\int_o^T f(t)\,dt}$$
must be a maximum.

Taking the first differential co-efficients and equating to zero we have

$$\left(\int_o^T f(t)\,dt\right)^2 = f(t)\Big]_o^T \cdot \int_o^T \int f(t)\,dt\,.\,dt$$

Now the only function which satisfies this condition, that the square of its integral shall equal the product of the function and its double integral, is evidently that in which the integral is similar to the function, that is the sine curve.

Thus we have

$$\left(\int_o^{T=\frac{\pi}{2\omega}} E\sin\omega t\,dt\right)^2 = \frac{E^2}{\omega^2}$$

and

$$\int_o^{T=\frac{\pi}{2\omega}} \int E\sin\omega t\,dt\,.\,dt \times E\sin\omega t\Big]_o^{T=\frac{\pi}{2\omega}} = \frac{E^2}{\omega^2}$$

The sine curve of E. M. F. then is the curve which will impart the greatest average momentum to an electrical circuit for a given average alternating force; that is, it is the "best" curve for an alternating E. M. F. which is to be used to do useful work, for it is evident that all losses due to eddy currents, hysteresis, etc., will then also be a minimum. Of course if the alternating current were to be used directly for lighting or heating and the circuit were devoid of inductance, then as there would be no inertia to overcome in changing the current the ratio of the current to the E. M. F. would always remain constant and one form of the curve of E. M. F. would be just as *efficient* as another. It is, however, obvious that if the E. M. F. should at each reversal suddenly spring to its maximum value, then such a curve of E. M. F. would furnish the greatest amount of energy to the circuit for a definite *maximum* value of the force; but the total force applied, of course, would also be a maximum under these conditions and no increase in *efficiency* would be obtained.

The important case, however, is the case discussed by the London Electrician, in which the E. M. F. acts through the agency of the inertia of the circuit to transmit or transform electrical energy into useful work. In such a circuit the sine curve will allow the E. M. F. to be applied at such a rate that a definite amount of useful work may be secured with a minimum force. Consequently the efficiency of the apparatus as a whole will be increased on account of the reduced secondary losses arising from this minimum force applied.

NEW YORK CITY. F. W. DUNBAR.

Underwriters' Rules.

To the Editor of The Electrical World:

SIR:—Every little while we are treated to some change in underwriters' rules for wiring, or some change is suggested. It seems to me, however, and to other practical men who know, that what is rather needed is a uniform enforcement and interpretation of the rules we have. At present a conscientious man is at a great disadvantage in estimating on a job, for he cannot tell how the inspector will construe a certain rule, or whether it will be the same as on a similar job previously done. Neither can he tell whether the result will be the same whether he or a competitor gets the contract. I have been in the business since 1881, and have always tried to do what I thought safe, whether the rules required it or not, but have never felt sure that the inspector would hold the same idea on a question on successive visits. A friend came to me a few days ago seeking my opinion as to how some of the new rules were to be understood, as he was bidding on several houses, and I had to tell him that I did not think he had any chance at all, as he was anxious to do what would be considered a good safe job under the rules, and yet had to bid against a man who apparently can get anything passed. To show what some electricians can get the inspector to pass, a business block was lately wired with weather proof wire of so poor a quality that a piece of it could not be bent into a one inch ring without breaking the covering so as to show the wire. The work was concealed, and instead of bushings such as the rules require, pieces of unarmored conduit were used, and cut off *flush* with the beams, and the wires carried loosely down partitions with no protection at all. The job was approved by the inspector, notwithstanding that it had been objected to by the lighting company. Such work is not the exception, as one can see or hear of similar cases in different parts of the country, as every station man knows. Very recently I have seen transformers laid flat on wooden awnings, bolted direct to wooden walls, placed on walls with high pressure wires not more than six inches below windows of dwellings and the like. Equally careless and reckless inside work may also be noted; only a short time ago I saw an opera house in New England, that had been wired within two years, which was wired with underwriters' wire, part of it concealed.

I have heard practical men talk of any number of remedies, but could only agree that there is something wrong in the present system of electrical insurance inspection, and until this is remedied there is little room for conscientious men in the business.

A. H. BURNETT.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS
BY CARL HERING

ELECTRO-PHYSICS.

Photo Electric Researches.—A paper by Messrs. Elster & Geitel from "Wied. Ann.," vol. 52, page 434, is abstracted in the "Elek. Zeit.," July 12. Of the three alkaline metals, sodium, potassium and rubidium, potassium acts remarkably well with blue light, but with light of longer wave lengths there is little action; sodium shows an equal action from blue to yellow, but from there on the action diminishes rapidly; rubidium reacts with blue light about four times less than with yellow, while with red it is more than twice as sensitive as with blue; several further reactions are given.

Electricity.—The serial of Mr. Schwartze, on "Electricity in Connection with Other Physical Phenomena," is continued in the "Elek. Anz.," June 10, 17, 21, 28, July 1 and 8.

Atmospheric Electricity.—The electrical observations on the Sonnenblick Observatory, in the Austrian Alps, made by Messrs. Elster & Geitel, are summarized in the "Elek. Zeit.," July 12.

MAGNETISM.

Hysteresis in Magnetic Metals.—A paper from the German by Messrs. Geroza, Finzi and Mai is abstracted in "La Lum. Elec.," July 14. Experiments were made by placing small pieces of magnetic metals in increasing and decreasing magnetic fields and at the same time passing currents through the magnetic metal. A continuous current from the north to the south pole always diminished the magnetization; interrupted currents in the same direction increased the effect of weak fields and diminished the effect of more intense fields; if the current is passed from the south to the north pole it increases the magnetic effect both for continuous and interrupted currents; alternating currents increase the action of weak fields considerably, even though the magnetic metal had been previously traversed by a continuous current, but with intense magnetic fields the increase was produced only when the material had not been traversed previously by a current from north to south; in the opposite case the alternating current diminished the effect. They conclude that a current passed through the material produced in it a permanent modification which cannot be made to disappear by demagnetization by inversion. The curves representing the intensity of magnetization as a function of the intensity of the field have less points of inflection than when the pieces are not submitted to the action of the current; this effect becomes more apparent as the ratio of the intensity of the current to that of the field increases, and it is greater in soft forged iron than in hard iron or steel; with an alternating current of three amperes the hysteresis cycle disappeared completely for wrought iron. In the second series of experiments the magnetic material was surrounded by a small coil through which an alternating current passed, while subjected to a magnetic field; with a weak alternating current the hysteresis cycle disappeared completely; this was claimed to be all the more remarkable as the intensity of magnetization produced by weak fields is diminished by this alternating current, the curve under these conditions up to the saturation point does not differ materially from a straight line.

Magnetic Action of a Cylindrical Current.—In a brief paper by Mr. Lori in "La Lum. Elec.," he discusses theoretically the action on a magnetic pole of a current passing through a hollow cylindrical conductor whose walls are very thin, the current density being the same in all parts. He concludes that if the conductor is of infinite length the action will be zero if the pole is in the interior of the cylinder, no matter what position it is in; on this principle he suggests that an instrument might be constructed for studying the influence of magnetic masses on the direction of currents, as a needle in the interior of such a cylinder will move into the position of the earth's magnetic meridian. If the magnetic pole is situated outside of the conductor, the magnetic action of the current will be the same as if the whole current was concentrated in the axis of the cylinder, whatever be the position of the pole or the radius of the cylinder.

Generating Strong Magnetic Fields.—The apparatus and results of Dr. Du Bois, mentioned several times before in the Digest, are given in the "Elek. Zeit.," July 12, including the illustrations.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Apparatus for Testing the Magnetic Qualities of Iron.—A new and complete apparatus made by Hartmann & Braun is illustrated in the "Elek. Echo," July 14. It consists essentially of an electromagnet in connection with a spiral of bismuth wire (the resistance of which is a measure of the magnetic field), an ampere meter for the main current, a galvanometer and bridge, together with all the necessary apparatus, all mounted on one base: the scale of the bridge is such that the reading is directly in lines of force per square centimetre; the piece of iron to be tested must be cut accurately to a certain size; the whole is arranged so that it can be used by any one who is not necessarily an electrician.

Photometer for Incandescent Lamps.—The "Elek. Zeit.," July 19, publishes an illustrated description of a very convenient form of photometer made by Hartmann & Braun on the Joly principle, for the comparison of two incandescent lamps; it is only one metre long, requires no dark room and has a scale reading directly from one to tenfold; standard incandescent lamps, such are standardized at the Imperial Institute, are used as the standard of comparison.

Determining the Form of Periodic Curves.—An Academy paper by Mr. Janet is published in "La Lum. Elec.," July 14, in which he describes an application of his electro-chemical method for determining the form of periodic current curves as a function of time.

Hot Wire Recording Voltmeter.—The Holden instrument is described and illustrated in London "Lightning," July 12: the sag of a horizontal wire produces the deflection of a pointer of the usual recording type, moving over a horizontal recording drum.

Government Testing Bureau.—As stated some time ago, the Austrian Government is about to establish a bureau for the official testing of meters; according to the "Elek. Zeit.," July 19, that bureau will also undertake the official testing of dynamos and other electrical apparatus.

Electrophorus.—A simple apparatus for generating a continuous succession of sparks is described and illustrated in the "Elek. Echo," July 7.

DYNAMOS AND MOTORS.

Graphical Calculation of Dynamos.—The "Elek. Zeit.," July 19, contains an interesting article by Mr. Fischer-Hinnen, in which he shows how the most important problems in connection with the calculation of dynamos can be solved graphically and how much simpler the solutions then become. The article does not admit of being abstracted; he starts with the magnetization curve, in which the ordinates represent the flux density per square centimetre, the abscissas the ampere windings per centimetre of length of magnetic circuit; he calculates one point on the straight line curve representing the magnetic relation of the air space and adds these abscissas to those of the curve, with the aid of dividers, thus obtaining the characteristic. Besides determining the characteristic he discusses the graphical solution of the following: determination of the loss of volts in shunt machines, determination of the compound winding, determination of shunt regulators, transmission of power by means of two series machines and the calculation of railway motors; the article contains only simple mathematics and is recommended to those interested in the subject.

Siemens & Halske Dynamos and Apparatus.—A profusely illustrated article by Mr. Brunswick is begun in "La Lum. Elec.," July 14; the basis of the article is the exhibit of that company at the World's Fair, further information from the makers being added. The present portion is devoted to dynamos and apparatus, regulators, accumulator regulators, automatic cut-outs, etc.

TRANSFORMERS.

Transforming Single-phase into Three-phase Currents.—A correspondent to the "Elek. Zeit.," July 1, states that the system of Mr. Deri, described and illustrated in the Digest July 28, was patented by Mr. Wahlstroem in 1891. Mr. Meidinger states that he has made careful experiments with this system and has obtained very good results, both for starting and for running, but found that the uniformity of the rotating field is affected very materially by the load; that is, the phase difference, if originally 60 degrees, will be quite different for different loads, thus producing a strongly pulsating field, in which case the efficiency will no longer be in the same proportion, there being considerable heat developed in the armature; a characteristic noise will show that the uniformity of the field has been destroyed; the induction coil must therefore be adjusted for different loads and cannot be placed on the motor armature itself.

In "La Lum. Elec." July 14, Mr. Korda describes precisely the same method as that of Mr. Deri (see Digest, July 28), giving in addition the simple theory and adding that regulation of the self-induction coil is necessary.

ARC AND INCANDESCENT LIGHTS.

Experiments with Incandescent Lamps.—The London "Elec. Rev.," July 20, abstracts from the "Phil. Mag.," for July, a paper by Mr. Bleekrode. Four similar lamps were connected in parallel, the first being filled with carbon dioxide, the second with coal gas, the third with hydrogen, while the fourth contained the usual vacuum; on all of these a small piece of phosphorus was placed on the top and on the outside of the bulb; it was observed that the phosphorus became ignited at different times; it burnt first on the lamps containing the gases, while on that containing a vacuum it remained intact for a long time, from which it might be inferred that the dark heat rays are very imperfectly transmitted by the vacuum, the convection being also very much less; it is argued that the degree of rarefaction should be made as high as possible.

Manufacture of Incandescent Lamps.—The serial by Mr. Kreuger is

continued in the "Elek. Anz.," July 12, and concluded in the issue of July 19.

TRANSMISSION OF POWER.

Transmission and Distribution of Power.—Some years ago the Industrial Society of Muelhausen offered a prize for the best plant for the electrical distribution of 20,000 h. p. throughout the whole city for industrial purposes; three prizes were awarded for three different plants; these are given at some length, together with the estimates, in the "Elek. Zeit.," the plant of Messrs. Zweifel & Hoffmann, who were awarded the first prize, being described in the issue of July 12; a three-wire continuous-current system of twice 750 volts was proposed; some of the figures are of general interest although much of the description is of local interest only. The issue of July 19 contains in abstract a description of the proposed plan of Desroziers and that of Messrs. Burghardt and Lanhoffer.

ELECTRIC RAILWAYS.

Electric Traction.—The serial by Mr. Wilkinson is continued in the London "Electrical Plant," July 1; it is chiefly of local interest; he believes it would be one of the greatest aids to the adoption of electric traction in England, if an over-running trolley were used, running on wires on the side of the street and connected by a flexible conductor with the car. By way of comparison he states that in England there are three electric lines with a total length of less than 20 miles (apparently not including the Liverpool and the City and South London Line), while in the United States there are over 1,000 lines of over 6,000 miles in length.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Large Private Plants.—In the "Elek. Zeit.," July 12, Mr. Uppenborn gives a well illustrated description of an installation at a large asylum; in order to provide a safeguard against the extinguishing of all the lights, a three-wire system was used, alternate lamps being always placed on alternate sides of the system, so that in the failure of one of the mains or one set of generators, not more than half the lights will be extinguished; for this reason the neutral wire was made larger than usual and in order that it shall always be in circuit no fuses are connected with it; all branches to single lamps or to groups of lamps are protected with double pole fuses.

Halles.—A description of this installation, including chiefly the modifications which have been made in it and a criticism of it, is begun by Mr. Claude in "La Lum. Elec.," July 14, and continued in the issue of July 21.

Switch.—The Metzger switch is described with the aid of a large number of illustrations, in "La Lum. Elec.," July 21; simplicity in the manufacture is claimed as the chief advantage.

Accumulator Systems.—See abstract under "Siemens & Halske Dynamos and Apparatus."

Three-phase Distribution System.—According to the "Elek. Zeit.," July 19, an installation of 220 h. p. is to be installed at Laegerdorf.

Central Stations.—The Lond. "Elec. Rev.," July 20, contains well-illustrated descriptions, including a number of general and detailed views, of the three municipal stations at Derby, Manchester and Burton. London "Lightning," June 21, publishes under separate cover a supplement giving a brief illustrated description of the Burton station. A translation in abstract of the description of the Caen station is briefly given in the Lond. "Elec. Eng.," July 20.

WIRES, WIRING AND CONDUITS.

Band Wire.—The "Elek. Zeit.," July 12, mentions a wire made in Germany, in which the two wires are wound with waterproof non-inflammable insulating material, the whole forming a sort of band, the wires being kept a certain distance apart and the insulating material serving to secure the double wire on walls, ceilings, etc.

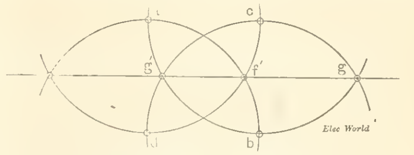
Line Wire Insulator.—A new form of insulator is described and illustrated in the "Elek. Anz.," July 15; the wire is clamped between the two separable halves of the insulator by means of a little ridge in the hole which holds it longitudinally.

Material and Construction.—The "Elek. Echo," June 23, 30 and July 7, contains an article by Mr. Arens on the material and construction in electric lines for telegraphs, telephones, lighting, etc, in which he gives rules, regulations, formulas, constants and other similar information.

Electric Lines.—The "Elek. Zeit.," July 19, abstracts from an official Italian journal the recently enacted laws of that country regarding electric lines for tramways and industrial purposes. The report of a French Commission on the same subject is published at some length in "La Lum. Elec.," July 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Inductionless Telephone Loops.—Mr. Hintermayr, in the "Elek. Zeit.," July 19, describes the following system for running three loops on overhead telephone lines in such a way that they are free from induction toward each other; if a and b represent the position of one loop on the poles, c and d that of the second, then f and g, determined as shown by drawing the circles with the other points as centres, will be the position of the third line; in practice the points f′, g′ will naturally be preferred; only this third line need be crossed and that only once at a point about midway between the ends; for the distance between a and c, which is equal to that between c and b, he suggests 24 to 28 inches; in practice this arrangement proved itself to be effective; every word sent through one of the first lines could be heard on the third line before it



INDUCTIONLESS TELEPHONE LOOP.

was crossed in the middle, but after the cross connection was made there was absolutely no cross talk.

Printing Telegraph.—The Maguin system is described and illustrated in "La Lum. Elec.," July 14.

A Bridge Telephone.—A short illustrated description is given in "La Lum. Elec.," July 14.

Railway Signals.—The Siemens & Halske and the Aspinall systems are described and illustrated in "La Lum. Elec.," July 14.

ELECTRO-CHEMISTRY.

Mulden Accumulator.—The "Elek. Anz.," July 15, publishes an illustrated description; the grid is in the nature of a somewhat complicated casting, which consists essentially of a number of perforated shelves, in which the active material is held. Attention is called to the expansion of the active material during formation, which is generally a cause of trouble; 100 grs. of lead are said to form 132.29 grs. of peroxide, and 100 grs. of minium form 104 grs. of peroxide.

Peyrusson Accumulators.—An illustrated description is given in "La Lum. Elec.," July 14.

Purification of Sugar.—A paper by Mr. Daix, read at the recent Congress, abstracted from "Genie Civil," is published in "La Lum. Elec.," July 21, in which several processes are described.

Practical Electrolysis of Chlorides.—An article by Mr. Andreoli is begun in "La Lum. Elec.," July 14, and continued July 21.

Galvanic Polarization.—The Lond. "Elec. Rev.," July 20, recommends a paper by Mr. Wiedeburg in the "Ann. Chem. u Phys.," vol. 51, page 302, which is said to be an important step in the codification of the laws; he seeks to give a coherent exposition of all the leading phenomena of galvanic polarization on the following fundamental assumptions: "The ions are driven by the active electromotive force toward the two electrodes, where they collect and generate new breaks in the potential, which, acting against the original electromotive force, regulate the current according to Ohm's law. All the ions that reach the electrodes, however, are not assumed to be electrically active, but only a comparatively small portion of them. The rest are neutralized, thus losing their ionic character, and contributing nothing to the sudden difference of potential which sets in. Wiedeburg assumes, also, that there is a limit to the gathering of the ions at the electrodes, and the relative amount which collects at any instant is smaller the nearer the amount already collected is to the limit, being proportional to the difference between the limiting and actual values at the instant considered." Some, it is thought, will be disposed to challenge these assumptions, but it will at least be admitted that the exposition which is based upon them is deserving of very considerable attention.

Caustic Soda.—A note in the Lond. "Elec. Rev.," July 20, mentions that in a recently devised process of Mr. Craney, electrolysis was used as an adjunct to other manufacturing processes, but the decomposition of the salt solution is carried only to the extent of producing a 1 or 2 per cent. solution of caustic soda, which is drawn off and its place supplied by water of condensation from the evaporators in which the soda is obtained in the more concentrated form; there is a constant supply of raw material and a continuous removal of soda; the object of the process is greater economy, which is said to be effected in a high degree if the plant is kept in continuous action; nothing is said about the chlorine.

Accident.—A curious accident, which happened in St. Petersburg, is described in the "Elek. Zeit.," July 12; a telegraph lineman while at work on a pole was suddenly struck by lightning and killed, showing 19 burns; during that time the sky was perfectly clear and no signs of a storm were visible, but it was found that at a city 68 miles distant there had been a very severe thunder storm.

Treatment in Case of Accident.—A paper by Dr. Mehler is published in the "Elek. Echo," July 7; he describes how the burns should be treated and how to induce artificial respiration. The same issue reprints an article describing the various effects on the human body produced by lightning and other strong currents.

Mine Drilling Machine.—The machine of Siemens & Halske is illustrated in the "Elek. Anz.," July 8; the motor, which is on the ground, is connected to the drill by means of a flexible shaft.

Electric Buoy.—The Lenard system of anchoring is illustrated in "La Lum. Elec.," July 21; the anchoring chains are connected at their middle point to floats.

Indicating the Position of Vessels.—A device by Mr. Sleeman is described briefly in the Lond. "Elec. Eng.," July 20; it is applicable to

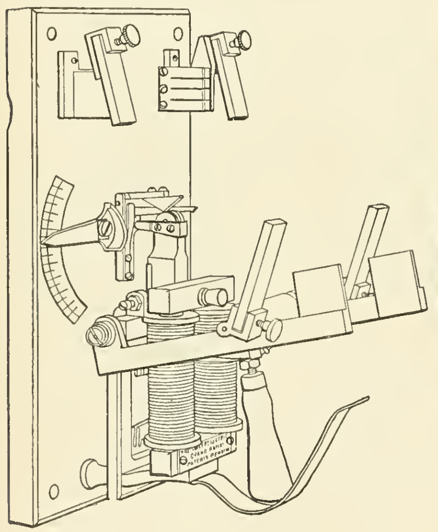
any vessel which is to be run and directed without any human agency on the vessel itself, as for instance, to a torpedo; an electric cable is paid out from the vessel as it proceeds; the direction of the vessel, as determined by a compass on board, is indicated at any moment to the person at the directing station; this avoids the use of masts or floats which are usually attached to torpedoes and are visible to the operator.

A New Furnace.—In Mr. Girard's furnace, briefly mentioned in the Lond. "Elec. Rev.," July 20, the material to be treated is passed into the furnace in the form of a continuous rod which is made one pole of the arc, instead of feeding the material in the form of a finely divided powder; the temperature can be regulated by adjusting the rate of travel of this rod; in this furnace the smelting can take place in an atmosphere of any gas at any pressure, while either the material or the arc is made to rotate by means of an electromagnetic device.

Electric Tanning.—The "Elek. Echo," June 23, abstracts a description from a German tanning journal, of the electric plant in Switzerland using the Groth system, in which the process is described and data given regarding the installation.

The Sweet Limit Switch.

There has long been a demand for an appliance to take the place of the never to be depended upon fuse wire. A device of this nature has recently been placed upon the market by the Sweet Electric and Manufacturing Company, of Grand Rapids, Mich., which, both electrically and mechanically is just as positive as an ampere meter; as the ampere meter indicates the volume of current at the point of distribution, so the limit switch, if set to the number of amperes required, will open the circuit of distribution on the predetermined current. The adjustment of the machine is controlled inversely as the square of the distance of the armatures on the machine to that of the field piece; so that mechanically the pull or work the machine has to do to open a circuit is practically constant whether on 1 or 500 amperes; any further than one ampere has less distance to pull the load than 500 amperes.



Limit Switch.

They are made for use in all pressures—from ¼ of one volt to 10,000 volts, if required. The breaking of the circuit is off of carbons in such a manner that when the metal contact is broken the contact is made on carbons which are rotating, throwing in a resistance so that before breaking the final point of contact the volume is greatly reduced and the arc broken, leaving no possible chance to carbonize the air, as the motion is very rapid.

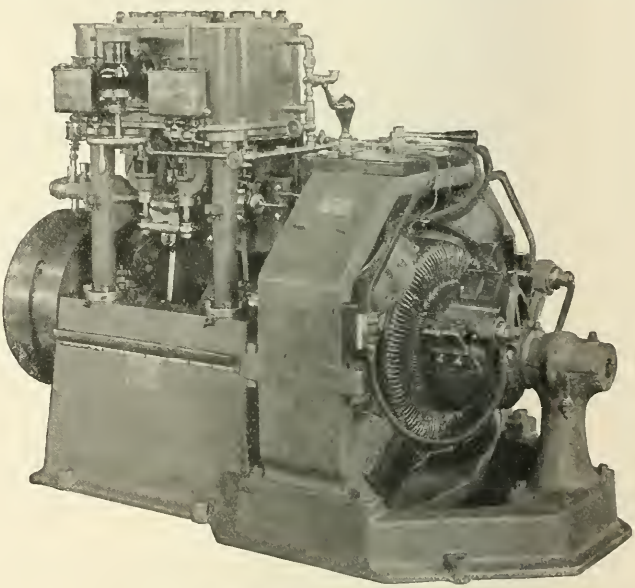
The sensitiveness of the machine is in its mechanical and electrical construction. It has two coils from which the arms swings above the centres and the locking and opening of the machine is attached to a fibre suspension directly attached to the armature with a steel roller which follows over a steel plate cut in such shape that when the armature begins to move the roller in passing over the projected steel plate, the force of the suspended arm is increasing rapidly, and the unlocking of the lever takes place with this force. As soon as unlatched, the rotating carbons with their outward pressure, which is given them by springs attached, make the opening of the machine positive in every detail, so positive and delicate in its adjustment that in the larger sizes, 200 to 700 amperes capacity, the device will open on less than ¼ of one ampere over and above its set capacity, and in the smaller sizes, ½ to 200 amperes, on less than 1-20 of one ampere.

This is adapted to all electrical currents, stationary and isolated plants, stationary motors and dynamos, for house wiring and also in a special pattern for street car motors.

Marine Generating Plant.

The illumination of vessels by electricity instead of the smoky oil lamp has so rapidly extended that it may be said there is hardly a steamship which has a due respect for the place it occupies in Nature's scheme which is not equipped with an electric lighting plant. This is partly due to the example set on land, but mainly to the fact that the apparatus to fulfill the requirements of marine service and cope with the conditions which obtain on board ship has reached a high degree of perfection. We illustrate a small marine generating plant which is demonstrative of this fact and which has only recently been placed on the market by the General Electric Company.

The engine of the combination is of the automatic cut-off type, double and vertical, and is rated on a basis of 80 pounds initial steam pressure one quarter cut-off. This leaves a liberal reserve capacity above the rating given, and the engine can be run under any steam pressure between 60 and 100 pounds. All the parts are accurately cut, so that in case of necessary repairs in fitting delay is avoided. All bearing surfaces are carefully fitted and flat surfaces scraped to surface plates. The crank shaft is of hammered Bessemer steel made in one piece, while the connecting rod is of forged steel with babbitted boxes. The cross head is of a crucible steel casting with babbitted wearing surfaces and the main bearings are provided with interchangeable babbitted cast iron boxes, and are of extra length.



Marine Generating Plant.

The dynamo is well protected with oil guards, and guards are furnished for all places where oil is liable to be thrown. The oiling arrangement is such that the engine may be run continuously without stop, and the bed is so constructed that all the waste oil is collected in one pit, from which it may be drawn, strained and again used. The governor is of very simple construction, its parts are readily accessible and are always in sight. All those parts of the combination subject to wear are made of hardened tool steel.

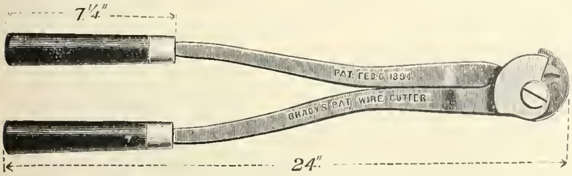
The variation in speed from extreme light load to the full capacity of the dynamo does not exceed four per cent., and full load may be thrown on or off with not more than four per cent. increase or decrease in the speed. The connection between the engine and dynamo is made through a solid flange coupling especially constructed for a ready and easy disconnection of the armature. The armature is of the smooth body type and the entire load may be thrown on without shifting the brushes and without sparking. The sets are built in four sizes, 15, 30, 40, and 50 kw.

Those combinations, while primarily intended for marine work, are also especially adapted for isolated plants in hotels, theatres, office buildings, etc., and all the qualities which characterize them will be found equally advantageous whether the plant be on land or aboard.

Safety Wire Cutter.

One of the most useful devices, not only to the lineman, but to every one who is obliged at any time to handle live wires, is the safety wire cutter. While apparently a simple piece of apparatus, the need of a wire cutter that would cut with ease, was practically indestructible and had perfectly insulated handles, has often been felt. Mr. James Brady, of the Brady Manufacturing Company, 83 Washington street, Brooklyn, N. Y., has patented and placed upon the market a wire cutter which seems to fulfill all these requirements. Its dimensions and form are shown in the accompanying illustration.

This cutter is made of steel drop forgings, and has vulcanized fibre handles; the best known material, combining great strength and perfect



SAFETY WIRE CUTTER.

insulation. The cutter blades are drop forged, of the best tool steel. All parts are interchangeable, making it always possible to replace broken or worn out parts. The cutter blades are so constructed that, as they are ground away in sharpening, they can, by the Brady patented arrangement, be set around one notch at a time, and this can be repeated until the blade is used up, when a new set of blades can be inserted, thus making the cutter as good as new. This can be repeated indefinitely, as all other parts are practically indestructible. The handles are very carefully insulated and live wires and cables can be cut with perfect safety.

The Manufacture of Armature Discs.

The three accompanying cuts show some improved machinery made by the E. W. Bliss Company, 12 Adams street, Brooklyn, N. Y. They are largely used in the making of armature discs for electrical machines. Fig. 1. represents a No. 95 double pitman press and is used for blanking out rings for discs, which is usually done in a combined double die cutting the inside and outside ring at the same stroke; this leaves a plain ring ready for the No. 61 notching machine represented by Fig. 2.

Sometimes the notches in these discs are punched at the same stroke that the centre is cut by, this method making a complete notched ring at every stroke of the press. This method, however, calls for fine, delicate dies, which are so expensive that it is not of general use, it being much cheaper to make the plain punched ring and then put it in the No. 61 press.

This press has an accurate dial feed carrying the blank under the notching die and cutting from one to six notches at a time, as may be desired. The disc is easily placed in position and held by adjustable

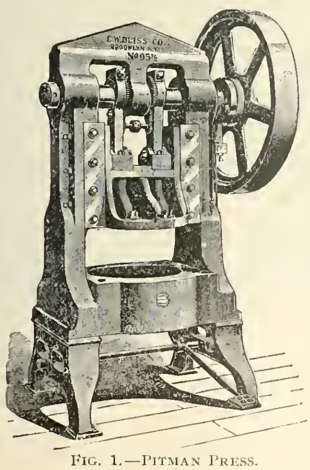


FIG. 1.—PITMAN PRESS.

clamps. After the notching is done the disc is easily removed. This press can also be arranged so that as the last notch is punched it will stop itself automatically. It is adjustable to different diameters ranging from twelve up to forty-eight inches, all its motions are well designed for their purpose and all the working parts are accessible and in sight. There are a large number of these machines now in practical use and giving the best of satisfaction.

The smaller machine (Fig. 3) is of recent design and is intended for

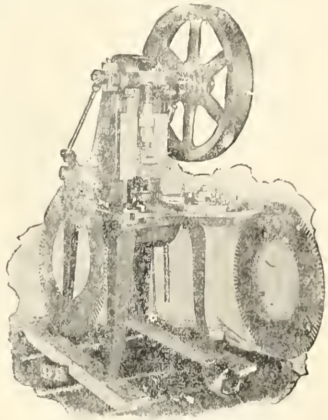


FIG. 2.—NOTCHING MACHINE.

rolling down the burrs sometimes caused by the wear of the dies and punches, thus leaving a slight roughness on the blanks punched. After such blanks or sections are passed between the rolls they are quite

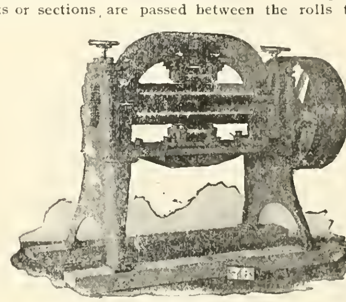
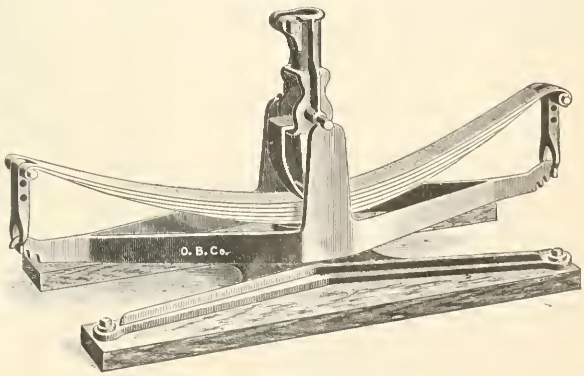


FIG. 3.—ROLLING MACHINE.

smooth and will lie close to each other and pack tightly when used in a dynamo or other machine. This rolling machine has all the needed adjustments, etc., that are necessary for the proper performance of its work.

The Ohio Trolley.

The Ohio trolley, manufactured by the Ohio Brass Company of Mansfield, O., is one of the simplest and most effective on the market. It is



IMPROVED TROLLEY.

made up of less than a dozen pieces, any of which can be easily duplicated. The spring is the regular flat leaf style, such as any manufacturer of carriage springs keeps in stock.

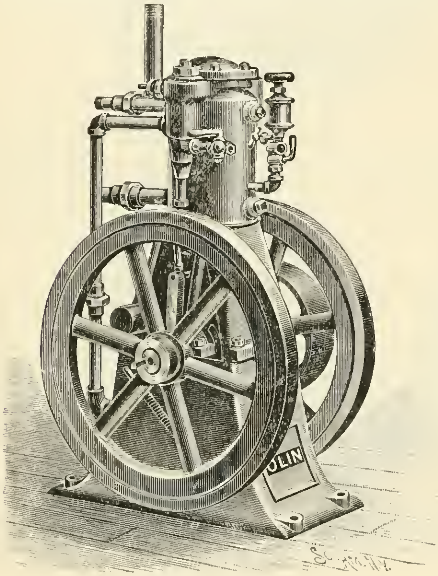
The working parts of the trolley are made of steel and malleable and

wrought iron and in consequence are not easily broken and do not get out of repair. The base and stand are 3 feet long and 8 inches wide, and when the trolley pole is in a horizontal position but 13 inches high. The trolley pole can be swung either forward or backward or in a complete circle, and the pressure against the trolley wire diminishes as the pole assumes more nearly a horizontal position. The trolley can be assembled or dismantled in a few minutes' time without the aid of tools. It is very easy and flexible in action, and will follow the variations of the trolley wire quickly and surely.

In fitting these trolleys out complete, the Ohio Brass Company use the special carbonized steel trolley pole. This pole is drawn cold through a die and is made of the best Norway iron. It is then carbonized to the proper degree to give it sufficient elasticity. It is seamless and endless, and formed to a perfect taper. The claim made on this pole is that it is lighter, more flexible and stronger than the regular style trolley pole. It will not break, and if bent out of shape can be straightened cold without injury.

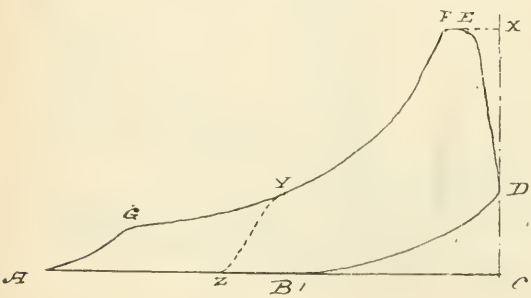
A New Gas Engine.

The accompanying cut shows a gas engine in which the defects inherent in other engines have been so far overcome that remarkable results have been accomplished by it. It is extremely simple in design, having a



IMPROVED GAS ENGINE.

low center of gravity, and all the working parts so arranged as to be immediately accessible in case any trouble should occur. It is made in sizes from ⅓ h.p. to 25 h.p. and consumers in the small sizes about twenty feet of gas per horse power per hour while in the larger sizes but fifteen cubic feet is consumed. One of the most successful uses to which these engines have been put is for isolated electric plants. The accom-



INDICATOR CARD.

panying cut of an indicator card taken from a 15 h.p. engine of this make shows better than any description to what perfection the engines have been brought.

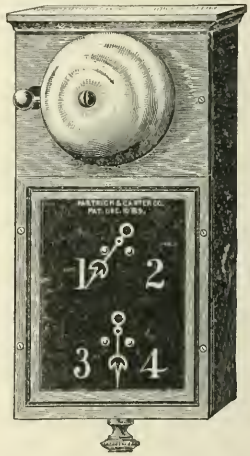
Starting at the point A the exhaust line coincides with the atmospheric line until one-half the return stroke is reached when compression begins, and at point D it has compressed to 46 pounds; ignition then occurs and the pressure rises to 138 pounds with only five-eighths of an inch of piston movement. The pressure holds for a moment, and then drops through the expansion curve F G nearly to the end of the stroke, the exhaust valve opening at G when the pressure is but 24 pounds. The cylinder of the engine from which this card was taken is eight by ten inches. The engine was running at 220 revolutions and an eighty pound spring was used in the indicator.

The engine receives a charge every revolution instead of every second revolution as in most gas engines, the clearing of the cylinder of foul gases being accomplished in a very simple manner without the use of an auxiliary cylinder which is sometimes resorted to. The most striking thing about this card is the length of the expansion line. In other engines the compression starts at the beginning of the stroke and exhaust takes place at a much higher pressure; hence a card would be similar to this one except the exhaust line would be at YZ instead of GA, and about thirty per cent. advantage from expansion would be lost which in this engine is utilized, and a corresponding amount of gas saved.

The engine is built by the Olin Gas Engine Company, of Buffalo, and the New York agents are the Ruggles-Coles Engineering Company, 39 Cortlandt street.

"New" King Annunciator.

The accompanying illustration shows the new form of the well-known King annunciator which has just been brought out by the Partrick & Carter Company, 125 South Second street, Philadelphia. The bell of this annunciator has the same movement as that in the wood box bells manufactured by this company. This bell is of the very best mechan-

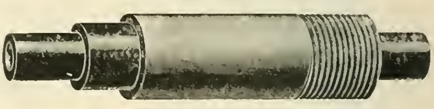


NEW KING ANNUNCIATOR.

ical workmanship, perfect in all its working parts, and thoroughly reliable. The bell is movable so that the different parts may be readily examined without taking the annunciator from the wall. At present it is made in four sizes only, with oak and walnut cases and glass front.

Telescopic Iron Armored Insulating Conduit for Underground Work.

The telescopic insulating conduit with an iron armor, which we herewith illustrate, is the latest addition to the underground conduit system of the Interior Conduit and Insulation Company, 42-44 Broad street, New York city. The telescopic arrangement, whereby lengths of plain insu-



TELESCOPIC IRON ARMORED INSULATING CONDUIT.

ating conduit are slipped into lengths of the iron armored insulating conduit so that the sections break in the centres of the lengths, gives a double insulation, and at the same time an iron armor for protection. The lengths are coupled together by straight threading the ends, and abutting them in the centre of the coupling, thus producing an underground conduit that is thoroughly waterproof, lasting and possessing the highest insulating qualities, so high, in fact, that bare wires can be drawn in with the certainty of perfect results. This system is complete in details, including junction boxes, etc., and is now in actual use in the underground construction of the Johnson-Lundell Electric Railway at East Sixty-ninth street and First avenue, New York.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, August 11, 1894.

THE ELECTRICAL STOCK MARKET, while evincing no special features, is appreciating with the tone of the market in general. Statements of earnings for the last few months compare favorably with those of 1893, and there are good prospects ahead for most of the companies.

GENERAL ELECTRIC seems to be again on the upward move. The burning of Siemens & Halske Electric Company's works at Chicago has been one of the features to boost the stock. This company is one of the General Electric Company's chief rivals, and the destruction of the Chicago plant has checked a powerful competitor. But it is doubtful if Siemens & Halske people will stop manufacturing for any length of time, as they are now looking for shops capable of continuing the work on their contracts, and have already secured machinery to manufacture light apparatus. One of the other reasons that gave General Electric a rise is the continued statements of increasing business. President Coffin says the company did about 40 per cent. of its last year's business in the first six months of 1894. These increasing business stories, the general bull feeling in the market, and the burning of the Siemens & Halske plant have been favorable to the stock. An instance is reported of a seller who received 36½ for his stock, when he had been prepared to sell at 36¼. The stock closed for the week at 38¼.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, in its July statement of comparative earnings shows an increase of $5,773 in the gross and $6,230 in the net over those of last year. The earnings for the first seven months of this year were: Gross, $774,402.68; net, $415,372.50. This is an increase of $83,673.20 in the gross and $99,572.35 in the net earnings over those of 1893. It was announced during the week that the company would establish a storage battery plant on Eighth street near Fourth avenue, and that the Electric Storage Battery Company, of Philadelphia, would supply the batteries. This is but partially correct. The company has under consideration the establishment of a storage battery plant at this location, but the Illuminating people have not yet made a contract with any company to furnish the batteries. As there is not a heavy demand for electric service in this section of the city, the plan of using accumulators instead of dynamos is considered, in order to economize in operating expenses. The first cost of a storage battery plant is said to nearly equal that of a dynamo plant of the same capacity, but if the company uses the accumulators, they will be charged from the unused day circuits of the big stations. As these stations can furnish service in their respective districts way ahead of all present demands, a storage battery plant is thought to be an expedient method of electric lighting a small section of the city.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, reports for July: Gross earnings, $27,139; increase, $8,882; net earnings, $8,057; increase, $3,976. With the other sources of income, less the interest on bonds, there is left $6,597 for dividends, which is an increase of $3,591 over last year.

WESTERN UNION TELEGRAPH has sold well during the week and made an advance of 3¼ points. There seems to be a growing opinion in Wall street that the Vigilant-Britannia yacht races are paving the way to the listing of Western Union on the London Stock Exchange. Whether prices went up on this supposition or not is a question, but the stock is now pretty strong.

BELL TELEPHONE has had another week of slight advances, and has climbed to the 200 notch again. Representative R. A. Childs, of Illinois, has presented in the National House a petition signed by ex-Solicitor General Charles H. Aldrich, of Chicago, Ill., against pending bills designed to lengthen the lives of Bell Telephone patents, which from lawful causes are about to expire. The petition has had no effect on the stock as yet, however.

WESTINGHOUSE ELECTRIC holds firm, and the company is getting a good slice of the electric business. Better progress is being made at the new works at Brinton, Pa., than the company expected, and it is now thought that the end of the year will see the Westinghouse Electric & Manufacturing Company entirely established in its new works.

THE ERIE TELEPHONE has declared a quarterly dividend of 1 per cent., payable August 20. Books close August 1.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	97¾	98¼
* " " " Brooklyn	100	101	103
* " " " Boston	100	117	120
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	1	2
General Electric	100	38¼	38½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref	50	50½	51½

BONDS.

	Par.	Bid.	Asked.
Edison Electric Ill., New York	1,000	106½	107
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86¼	86½

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	199½	200
American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
Gold & Stock Telegraph	100	100	102
* Mexican Telegraph	100	190	200
* Western Union Telegraph	100	88¼	88⅛

* Ex. div.

NEW INCORPORATIONS.

THE CHICAGO HARRISON TELEPHONE COMPANY, Chicago, Ill., capital stock $4,000,000, has been incorporated by T. Whitney, M. A. Rose and C. R. H. Hughes.

THE BELDING ELECTRIC MAIL BOX COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated by E. C. T. Belding, T. W. Saunders and C. Stuart Beattie.

THE CHEVY CHASE & KENSINGTON RAILROAD COMPANY, Chevy Chase, Md., has been organized to build an electric railway. O. R. Harr, president; A. Ray, vice-president; W. H. Walker, secretary.

THE STANDARD TELEGRAPH AND TELEPHONE COMPANY, Cleveland, O., capital stock $50,000, has been incorporated by F. Rockfeller, T. B. Squires and others to construct a magnetic telegraph and telephone line.

THE ROBERTSON INSULATED CONDUIT ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000, has been incorporated by J. L. Murphy, S. H. Gracey, H. B. McMillan, B. W. Sherman, W. Osgood and C. A. Dye.

THE ROBERTSON INSULATED CONDUIT ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000. Incorporators: J. Luttrell Murphy, Smith H. Bracey, Hamilton B. McMillan, Bernis W. Sherman, William Osgood and Charles A. Dye.

THE POTTSVILLE TRACTION COMPANY, Pottsville, Pa., capital stock $200,000, has been formed to build and operate a street railway. J. L. Kaufman, New Cumberland; L. S. Sadler and W. F. Sadler, Jr., Carlisle, Pa., are the promoters.

THE RANDALLSTOWN, HARRISONVILLE & GRANITE ROAD TRANSIT COMPANY, Pikesville, Md., has been organized to build an electric road from Pikesville to Randallstown, and employing a system invented by C. H. Barrow, which employs but one rail.

THE EUREKA ELECTRIC COMPANY, San Francisco, Cal., capital stock $100,000, has been formed to manufacture electrical apparatus. The promoters are H. A. Smith, J. H. Lawrence, M. S. Lawrence, Alameda; Arthur Hough and E. A. Hough, Oakland, Cal.

Special Correspondence.

NEW YORK NOTES.

NEW YORK, August 13, 1894

MR. H. B. COHO, of H. B. Coho & Co., has recovered from his attack of typhoid fever and is once again at work.

MR. CHAS. W. SEITZ, New York State traveling salesman for Charles A. Schieren & Co., of New York, reports business comparatively good.

MR. HENRY MULLER, JR., one of the pioneers in the carbon manufacturing business, and founder of the New York Carbon Works, has resigned his positon of secretary and treasurer of that company.

PROF. ALEXANDER M'FARLANE, of the University of Texas, was a recent caller at The Electrical World's offices. He is attending the annual meeting of the American Association for the Advancement of Science.

MR. G. WILFRED PEARCE, the affable superintendent of the New Jersey Lamp and Bronze Works, of New Brunswick, N. J., paid his respects to The Electrical World last week. Mr. Pearce is a delegate to the State convention at Saratoga, and is an energetic and promising politician.

MR. W. H. STEVENSON, president of the Hoggson Electric Date and Time Stamp Company, of St. Louis, Mo., was in the city last week. Mr. Stevenson reports general business very good in St. Louis, perceptibly little affected by the general depression existing thoughout the country. He is also much pleased with the sales of his stamp made by Mr. Auerbacher, general Eastern agent.

MR. W. J. MORRISON, the popular New York State agent of the Fort Wayne Electric Company, made a flying trip to the city last week, accompanied by A. H. Gluck, of Niagara Falls, N. Y., and were callers at The Electrical World's offices. Mr. Morrison reports having closed some nice orders recently. It is safe to say if there is any business in this State Mr. Morrison will have his share of it.

MR. H. B. OAKMAN, general Eastern agent of the Wenstrom Electric Company, Electrical Exchange, New York city, New York, reports having closed recently the following contracts: L. E. Weil & Co., Buffalo, 200-light dynamo; Macon Knitting Company, Macon, Ga., 600-light dynamo; Gold Bluff Mining Company, Downeyville, Cal.; 125-h.p. generator; 35-h.p. electric hoist; 5-h.p. electric pump; 2-h. p. electric blower.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., August 11, 1894.

LIEUT. S. DANA GREENE, it is rumored, will soon be announced as the general manager of the General Electric Company.

MR. J. M. ORFORD, assistant general manager of the Boston Electric Light Company, has just returned from a brief European trip and gives every evidence of healthful benefits therefrom. Mr. Orford is a tremendous worker, and needed very much the short rest he has taken.

MR. M. E. BAIRD, of the Eddy Electric Manufacturing Company, Windsor, Conn., was a recent Boston visitor, favoring this office with a call. Of the many capable representatives of the electrical industry, none are more popular than Mr. Baird. He probably covers more territory in a year than any other representative, and always accomplishes good business results for his company.

THE CONVENTION of the Association of Edison Illuminating Companies, to be held here next week, it is said will be the most interesting of all previous meetings. Certainly Mr. C. L. Edgar, of the Edison companies of Boston, is exerting himself to his utmost to provide nicely for the social side of the convention, and we venture the assertion that members of the association and their ladies in attendance will not soon forget Mr. Edgar or the many opportunities of social pleasure that Boston affords to visitors.

THE ELECTRIC HEAT ALARM COMPANY, of Boston, has just received a second and very flattering order from the Pullman company, Chicago, after several months' test of its former order. The business of this company is rapidly increasing, its apparatus is constantly being improved, and those capable of judging predict for it great prosperity in its particular field. General Manager Palmer is never idle, and it looks now as if his extraordinary energy, patience and confidence in his system is going to win excellent business results.

MR. J. P. McQUAIDE, secretary and treasurer of the National Conduit Manufacturing Company, of New York, has been in Boston quite frequently recently, and it is safe to assume that he is scoring good business points for his company. Over seven years ago the conduit manufactured by his company was adopted by the New England Telephone Company, of Boston, and has given perfect satisfaction as against all competitors, which is a strong card for it with other companies in Boston, who will be required now by legislation to place their wires underground.

COMMISSIONER MURPHY, of Boston, has unmistakably expressed himself on the subject of burying wires underground in that city, and according to his interpretation of the statute, no company is exempt from the provisions of the law. A conference has been held this week between the Commissioner and company representatives at the office of the wire department. In defining his policy, Commissioner Murphy said that he had no desire to proceed arbitrarily, and was willing to help the companies in every possible manner, but he gave them to understand that he would brook no delay, especially if he construed the delay to be an attempt to circumvent the law. He was compelled to work expeditiously, as the time for work this year is very limited.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY, of Penacook, N. H., and Sherbrooke, P. Q., Canada, reports business as excellent just now. Dr. A. H. Hoyt, electrician and general manager of the company, was seen recently at the Penacook factory—which, by the way, is a little gem—and spoke with confidence and enthusiasm as to the future of the company. Dr. Hoyt will soon introduce to the trade his latest invention, which was designed for alternating current work. By actual tests it has been demonstrated that this new instrument can be used on both alternating and direct current. It is built in such a way as to utilize the forces of repulsion and attraction for its operation. Its construction is unique, and it is giving some remarkable tests. The first instrument built (a voltmeter) was put in circuit with an alternating current dynamo having a period of 266. This was gradually reduced to 50 cycles without any perceptible change in its readings. It was then put on a direct current circuit, and the readings were correct to within 1-10 of 1 per cent. The instrument when ready for the market will be built with a scale 12 inches in length, with reading sufficiently wide apart to enable a person to see it from any part of a large station. Dr. Hoyt is one of the most pleasant of gentlemen, combines with his inventive genius first-class business ability, and it is confidently predicted that a good and profitable business will result to the company under his capable management.

MR. E. I. GARFIELD, late secretary of the General Electric Company and secretary of the Thomson-Houston Electric Company almost from its organization, and one of its most energetic and faithful officials, is now the New England manager of the Fort Wayne Electric corporation, with headquarters at 17 Federal street, Boston. The office is on the ground floor and is sufficiently spacious for a creditable display of the apparatus of the Fort Wayne corporation and the general transaction of business. The Fort Wayne corporation is certainly to be congratulated over having secured the valuable services of Mr. Garfield. He carries with him into his new position the friendship and best wishes of all who have the pleasure of a personal acquaintance with him, which, because of the prominent position he has held in the electrical field with the Thomson-Houston Companies and General Electric for over 12 years, means almost everybody in it. His acquaintance with central station managers and officials is widespread, and there are none, in New England particularly, to whom he is not personally known and highly esteemed. He was always the friend of central station managers, and at the same time did a large and profitable business with them always. It is already to be heard that if you want to meet any New England central station official, go to Mr. Garfield's office. He should certainly feel greatly gratified over the personal calls he is daily receiving and the personal letters his mail daily brings to him. Mr. Garfield is just in the prime of life, full of vigor, and a continuation of his past brilliant business career and successes is confidently predicted by his many friends.

News of the Week.

Telegraph and Telephone.

GAITHERSBURG, MD.—The Montgomery County Telephone Company is to extend its line to Rockville, five miles distant.

BROOKHAVEN, MASS.—A company has been organized to construct and operate a telephone line to Fair River and Monticello.

CHICAGO, ILL.—George Filbert, of Womelsdorf, Pa., has been elected president of the new Groff Telephone Company, which has its main office in the Borden Building. W. B. Brissel is vice-president and William Filbert secretary.

Electric Light and Power.

SOUTH HAVEN, MICH., is to have electric lights.

WACO, TEX.—Bids for the electric light plant will be received until October 3.

ROCHESTER, MINN.—The town of Rochester is to enlarge its electric light plant.

HELENA, ARK.—The Helena Gas Company is putting in an electric light plant.

BETHANY, MO., has just let a contract for an electric light plant and water works.

UTICA, N. Y.—The Council has the subject of electric subways under consideration.

TERRELL, TEX.—The Texas Midland Railroad Company is putting in an electric light plant.

HAGERSTOWN, MD.—Address the mayor regarding an electric fire alarm system to be put in.

GREEN LAKE, WIS.—The people of Green Lake are talking of putting in an electric light plant.

NAPOLEON, O.—The Fort Wayne Electric Company has been awarded the contract to light Napoleon.

COLUMBIA, O.—An election will be held to vote on the question of issuing $30,000 in bonds for electric light.

CENTERVILLE, MICH.—The Common Council of Centreville has decided to light the streets of the city with electricity.

LISBON, IA.—The village of Lisbon has voted to issue $13,000 in bonds for the erection of a water and electric light plant.

WINCHESTER, TENN.—Bracey Brothers and McNeir Company, of Chicago, have been awarded the contract to construct an electric light plant.

NILES, MICH.—The city of Niles has purchased the plant of the private company and will try municipal lighting. The price paid was $37,500.

WELLS, MINN.—The town of Wells has decided to issue bonds to the amount of $20,000 for the erection of an electric light plant and water works.

The Electric Railway.

ASBURY Park, N. J.—A trolley road from Asbury Park to Branchport is projected.

KEY WEST, FLA.—John J. Philbrick and others have been given a franchise to construct an electric railroad.

GREENVILLE, TEX.—Address the mayor concerning a franchise for an electrical railroad just granted by the city.

DAYTON, O.—The Oakwood & Dayton View Street Railway Company will change its power to electricity on three lines.

DANSVILLE, N. Y.—An electric street railway in Dansville to the Lackawanna road is again talked of with the probability that it is to be built.

NORRISTOWN, PA.—The Norristown & Conshocken trolley line will be extended from a point on the Plymouth pike, about five miles from Ambler.

SYRACUSE, N. Y.—Engineers are setting the stakes for the line of street railway which the Syracuse Street Railroad Company is to build to Solvay.

COLUMBUS, GA.—The Columbus Railroad Company will shortly change its motive power to electricity. It is now operating a steam dummy and a horse car line.

NEW BRUNSWICK, N. J.—The projectors of the New York & Philadelphia Traction Company are now trying to get the necessary legal permission to build their road from Raritan to this city.

LITTLESTOWN, PA.—A committee from Littlestown were in town to see President Hoffer, of the Electric Railway Company, with reference to building an extension to Littlestown and Westminster.

PHILIPSBURG, PA.—Work has been commenced on the electric railway destined to connect Philipsburg with Oscela, Houtzdale, Morrisdale, Mousom and other surrounding towns and mining villages.

PORT BYRON, N. Y.—Parties interested in the building of an electric railroad from Skaneateles, through Auburn to Port Byron, have been in Port Byron this week and report the prospects very favorable for the construction of the road.

DOYLESTOWN, PA.—The Bucks County Railway Company is to construct an electric line from Newtown to Doylestown. The capital stock is $100,000. Marshall S. Lynch, S. A. Hamilton and Robert C. Fulton, of Philadelphia, Pa., are interested.

TORONTO, CAN.—The Toronto Railway Company has purchased 250 feet frontage in Roncesvalles avenue, by a depth of 250 feet, and a large power house will be erected, from which the Mimico and the Weston electric car system will be worked. Car sheds will also be erected.

BUFFALO, N. Y.—The Council has declared the franchise given to the Lock City Electric Company void, on the ground that no work on it had been done for many months, and that the company had violated practically all its agreements with the city.

PATERSON, N. J.—A new company, with a capital of $10,000,000, has been incorporated at Trenton. It will establish electric railways from Paterson to Camden, via Trenton. The ultimate intention is to build an electric road from New York to the city of Philadelphia.

WAUKESHA, WIS.—It is reported that effort is being made to raise necessary funds to build an electric road from Waukesha to Pewaukee and thence skirt the lake region and end at Oconomowoc. Most of the right of way has been secured and it is hoped to begin the construction this Fall.

CALDWELL, N. J.—The Common Council of this place has decided to grant the North Jersey Street Railway Company a franchise to operate an electric line here, which is to run through Bloomfield avenue to Vernon, Montclair, Bloomfield and Newark, providing franchises can also be obtained in those places.

Personal Notes.

MR. W. S. ANDREWS, general manager of the Edison Illuminating Company, of Lancaster, Pa., has tendered his resignation to accept a position with the General Electric Company at Schenectady. Mr. Andrews entered the electrical field in 1879 in the employ of Thos. A. Edison, and has since then held numerous positions of responsibility with the Edison and other companies.

MR. WILLIAM F. CULLEN, of the E. P. Gleason Manufacturing Company, and well known to the electric light and fixture trade, died on August 9, at the age of 30. He first secured employment with the E. P. Gleason Manufacturing Company as errand boy twenty years ago. He was then made a salesman in the store and afterwards devoted his time to city trade with gas fixture houses. He showed particular aptitude in acquiring a thorough knowledge of the electric light business, and kept pace with the advances in this department. He always studied the wishes of his customers, and had a due regard for the inter-

ests of his employers. The advances made by the company in the electrical department are largely due to his energy and the interest taken by him in the success of the business. Mr. Cullen was unmarried and resided with his mother and sisters and one brother in the home provided for them by him at 258 East Seventh street, New York city.

THE FALKENAU ENGINEERING COMPANY, LTD., is the name of a new company which has recently been organized for the purpose of conducting a general businesss as mechanical and electrical engineers. Messrs. Arthur Falkenau, Edwin R. Keller, Clayton W. Pike and Elmer G. Willyoung constitute the company, and the prominence of these gentlemen in the electrical and mechanical fields, and their wide experience in engineering matters, promise well for the success of the company. Mr. A. Falkenau was born in New York city in 1856. His early education was obtained in the public schools of that city and in the College of the City of New York. After finishing the Freshman year at this institution, however, he left college and entered the shops of the Delamater Iron Works, where he served a regular machinist's apprenticeship, keeping up his studies, however, by attending the evening classes at the Cooper Institute. In the fall of '75 he entered the course in mechanical engineering at Cornell University, where he graduated in '78 as one of the honor men. After a short post graduate course in physics and chemistry, he entered practical life again as a draughtsman for the Brooklyn Elevated Railroad, at the same time teaching mathematics at the Workingman's Lyceum, and during the next two years enlarged his experience by holding positions as draughtsman for Wilson Bros. & Co., Wm. Sellers & Co. and I. P. Morris & Co., being especially called to the latter place to assist in the designing of Mr. E. D. Levitt's 5,200-h. p. hoisting engine for the Calumet and Hecla mines. In 1880, when the great discoveries of silver at Leadville, Col. attracted general attention Mr. Falkenau was persuaded to go to this mining camp, and he there opened an engineering office and became consulting engineer for a number of mining and smelting companies. Being urged by the managers of a mining and smelting company to establish a shop, he built a foundry and machine works, which soon became the largest in the region. He is still the proprietor of these, but overwork at this high altitude brought on illness, which necessitated his permanent return to the East. For two years he was assistant engineer of the Dickson Manufacturing Company, of Scranton, Pa., during which time he made an extended trip through Mexico. In 1888 Mr. Falkenau established a machine shop at Eleventh and Ridge avenue, Philadelphia. This is equipped with the most modern machinery tools and intended for the construction of special machinery of all kinds. During the last year he built all of the machinery and conduits for the first United States pneumatic postal system, which attracted considerable attention. While in Leadville Mr. Falkenau established a Workingman's Lyceum and contributed to the columns of several well-known technical journals. He is a member of the American Society of Mechanical Engineers and of the Engineers' Club, of Philadelphia, of which he is vice-president and one of the most active contributors. He is also a member of the Manufacturers' Club, of Philadelphia. Mr. Edwin R. Keller, the youngest son of Dr. William Keller, of Philadelphia, was born in Darmstadt, Germany, in 1869, his father being engaged at that time as director of the military hospital at Hesse-Darmstadt during the Franco-Prussian War. Mr. Keller received his early education in the public schools of Philadelphia, and in 1884 entered the University of Pennsylvania, choosing the course in mechanical engineering. He received the degree of B. S. in 1888 and that of M. E. in 1889, upon the presentation of a thesis, the result of an experimental and mathematical study of, the Otto gas engine. This work, carried on in conjunction with Edgar Kidwell now professor of mechanical engineering at the Michiga Minning School, was deemed of sufficient value by the college authorities to warrant publication in the Journal of the Franklin Institute. Mr. Keller was for two years engaged as instructor in mechanical engineering in the University of Pennsylvania, and spent one year in Hanover, Germany, as a student at the Technische Hochschule, studying electrical engineering under Prof. W. Kohlrausch and devoting some time also to the higher mathematics. He has also been engaged in practical engineering and machinists' work at Roach's shipyard, the Cambria Iron Works and Wm. Wharton, Jr. & Co.'s In the spring of 1893 he went to Chicago to represent at the World's Fair "Industries and Iron" (London), to which he had for several years been a contributor. Mr. Keller has also done some literary work. "Engineering Mechanics" contains two translations from his pen—Radinger on "High Speed Steam Engines," and Von Ihering on "Blowers and Blowing Machinery." Besides these he has written a number of shorter articles, including "Discussion on the Strength of Plate Glass," "The United States Government Timber Tests," notes on "Mechanical Drawing" (for the students of the University of Pennsylvania), and "The Calculation of Joint Resistances." He is a member of the American Institute of Electrical Engineers and of the Engineers' Club, of Philadelphia. Mr. Clayton W. Pike was born in Freyeburg, Me., in 1866. After graduating from the Fryeburg Academye in 1885, he entered the Freshman class at the Massachusetts Institute of Technology, choosing the course in electrical engineering, and was graduated in June, 1889, having presented to the faculty of the Department of Electrical Engineering a thesis embodying the results of an experimental study of the Thomson-Houston incandescent machine. During the summer of the same year Mr. Pike was engaged in perfecting an electrical igniter for the Brayton petroleum engine, and in the autumn he assumed complete charge of the electrical department of the Merrimack Manufacturing Company, at Lowell, Mass., the largest cotton manufacturing plant in Lowell, and one which employs a wide variety of electrical appliances. Besides the electric arc and incandescent light and the power work, the plant includes a complete telephone system, watchman's clock, fire alarm, electroplating plant and an enormous battery of primary cells operating the time service for all the mills in Lowell. During his stay the plant was remodeled and its capacity increased about one-third. In the fall of 1890 Mr. Pike accepted a call to take charge of the instruction in electrical engineering at the University of Pennsylvania. He remained there two years, and during this time was a prominent member of the Franklin Institute, acting on the library committee and on the electrical sub-committee of science and arts. In 1891 he visited the Frankfort Electrical Exposition for the purpose of increasing his knowledge of foreign apparatus. In the summer of 1892 Mr. Pike was offered professorships in electrical engineering in two of the Western universities, but, feeling that he was not yet ready to decide to make teaching his life work, he entered the employ of Queen & Co., Philadelphia, in their electrical department. It was decided early in the year to make extensive exhibits at the World's Fair, and Mr. Pike was selected to take charge of all of these—seven in number. Since his connection with the University of Pennsylvania, Mr. Pike has been called upon to act as consulting engineer, and also several articles on electrical matters have appeared in print: "A New Storage Battery Plate," "The Munich or Constant Shunt Method of Measuring Direct Current," "Notes on the Theory of Electric Wiring," "Notes on the Theory of Alternating Currents," "Effects of External Magnetizing Forces on the Reading of Weston Instruments," etc. Mr. Pike is a member of the American Institute of Electrical Engineers and the Franklin Institute, of the electrical section of which he is also vice-president. Mr. Elmer G. Willyoung was born June 24 at Buffalo, N. Y. When he was 12 years of age his parents moved to Detroit, Mich., where he obtained his collegiate preparation in the Detroit High School. He entered the University of Michigan in 1885 as a candidate for the civil engineering degree, but soon changed over to the general science course. In 1886 Prof. H. S. Carhart was called to the chair of physics at Ann Arbor, and Mr. Willyoung was appointed his assistant, a position he held until graduation. In 1888 he graduated with the degree of B. S., and immediately entered the employ of Queen & Co., of Philadelphia. The first year of his connection with that firm was spent in visiting the various colleges and universities in the United States, in order to become thoroughly acquainted with their needs and to secure the views of scientific investigators as to the best line upon which instruments should be built. The following year Mr. Willyoung located permanently at the Chestnut street store of Queen & Co., and undertook the construction of a complete line of electrical measuring instruments, which, previous to that time, had, with few exceptions, been imported from abroad. The testing and adjusting of instruments was at first done by the Mather Electric Company, under the supervision of Prof. Anthony, but the business grew so rapidly that in the fall of 1891 Queen & Co. decided to establish a laboratory of their own, and a large and complete building was erected at Ardmore, nine miles from Philadelphia. The development of the instrument business of this company under Mr. Willyoung's direction is too well known to need further mention here. Mr. Willyoung's name is familiar in the Patent Office, he having taken out patents on improvements in galvanometer construction, electrometers, electro-dynamometers, rheostats, testing sets, etc. He has also devoted special attention to exact resistance measurements, having devised several types of electrical comparators upon the Carey-Foster system. On this a joint award was given to him and Prof. Carhart by the World's Fair jury. The Acme meters recently brought out by Queen & Co. are the result of Mr Willyoung's study of the hot wire principle. Mr. Willyoung has contributed to the electrical and scientific press to a considerable extent, and now has a two-volume work on the subject of "Electrical Instruments and Measurements" in the press of D. Van Nostrand & Co. He is a member of the American Institute of Electrical Engineers, president of the electrical section of the Franklin Institute, and a member of the Engineers' Club, of Philadelphia.


A. FALKENAU.


C. W. PIKE.


E. R. KELLER.


E. G. WILLYOUNG.

MISCELLANEOUS NOTES.

"AERODYNAMICS" is the title of an article by Mr. S. D. Mott, in a recent issue of the Scientific American Supplement, in which the author presents an interesting analysis of the functions of a bird's wing during flight, and its mechanical imitation, with numerous illustrations.

THE NEW YORK EVENING POST recently contained a letter from Mr. M. J. Francisco, president of the National Electric Light Association, entitled "Some of Prof. Ely's Facts," in which Mr. Francisco called Prof. Ely to task for various statements made in his text book, entitled "Outline of Economics."

FAREWELL TO MR. KAPP.—A farewell dinner was recently given at the Whitehall Club, London, to Mr. Gisbert Kapp on the occasion of his departure for Berlin. Mr. W. H. Preece was the genial toast-master, and speeches or remarks were made by Messrs. Kapp, Preece, J. Swinburne, W. M. Mordey, F. H. Webb, H. Edmunds, Prof. W. E. Ayrton, Prof. A. B. W. Kennedy, Prof. S. P. Thompson and others. Mr. Kapp was presented with a handome gold watch and a silver salver, and an album for Mrs. Kapp.

INVENTIONS AND PATENTS.—Mr. Geo. G. Turri, in an article on this subject in a recent issue of the Melbourne (Australia) Herald, states that piracy (meaning that "importers or first introducers" can obtain a patent if their application is made before that of the real inventor) is legalized in Great Britain, Cape Colony, Ceylon, South Australia, Tasmania, Russia, Spain, Turkey, Denmark, Colombia, Ecuador, Bolivia; while in Canada, New South Wales, Victoria, Western Australia, India, Fiji, Queensland, United States, Austria, Belgium, Portugal, Germany, France, Switzerland, Norway, Sweden, Italy, Finland, Brazil, Chili, Argentine, Uruguay, Liberia, Venezuela, Guatemala and Mexico, only the inventor or his assignee can obtain a patent.

Trade and Industrial Notes.

THE FIBRE COMPANIES, it is reported, have reached an agreement to establish a uniform system of prices. A slight increase in prices is expected.

MESSRS. COHO & CO. have closed a contract for a 650-light Mather generator for the Hotel Minot, One Hundred and Twenty-fifth street and Eighth avenue, New York city.

PORTLAND, ME.—The Belknap Motor Company has recently added to its factory, increasing its floor space 7,000 feet and providing a convenient tool room and pattern shop.

J. JONES & SON report fitting up of the yacht Lorna, owned by Mr. W. L. Stow, a Wall street broker, which lately was in collision on the Sound and sunk, with a 19-light plant and search light and a storage battery system.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is furnishing the iron roof for the new boiler and dynamo room for the Larchmont Electric Company, at Mamaroneck, N. Y., and also of the Geo. W. Helme Company, at Helmetta, N. J., for the new roasting house.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, is meeting with marked success in the introduction of the Arnold magneto telephone, for which it is the general selling agent. The loud speaking and clear articulating qualities of the instrument especially recommend it.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY reports that during the past month its orders exceeded in number that of any other month in the history of the concern. June shipments exceeded $560,000, and July orders were largely in excess of that amount.

THE HARRISON INTERNATIONAL TELEPHONE CONSTRUCTION COMPANY, Chamber of Commerce Building, Chicago, has issued a leaflet entitled "What Our Decatur Patrons Say," being a collection of testimonials from its subscribers in Decatur, Ill., as to the efficiency of the Harrison telephones instaled there.

THE NEWTON ELECTRIC COMPANY, 39-41 Cortlandt street, New York city, manufacturer of electrical specialties, has issued an attractive catalogue, describing some of the more recent and important of the devices which it handles, including standard and cord sockets, cord pendants, fixture arm switches, shade holders, cut-outs, bell indicators, etc.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., has recently issued a neat catalogue containing illustrations and descriptions of the various apparatus which it manufactures, including Laclede and Hercules carbon batteries, cutouts of all sorts, fuse blocks, switches, lamp sockets, binding posts, insulator knobs, cleats, etc., etc.

STANLEY G. FLAGG & CO., North Nineteenth street and Pennsylvania avenue, Philadelphia, Pa., have issued a little circular price list of their new malleable iron mica-insulation joints for combination gas and electric fixtures. This device has been approved by the Underwriters' International Electrical Association, and is meeting with much favor.

THE AUTOMATIC ELECTRICAL SPECIALTY COMPANY, 136 Liberty street, New York City has recently acquired the selling agency for the Porter standard motors, which are the well known types made for battery and incandescent circuits. The company is also selling agents for the Hammer dry cells, which are made in all sizes. The 6x2½' cylindrical cell shows 12 amperes on a Weston tunneler. The company reports the sales of the Hoggson time stamp good.

THE FIFIELD TOOL COMPANY has recently moved its business to its splendid new factory on Marginal street, Lowell, where it has every facility for the manufacture of engine lathes, for which it has justly gained a wide reputation. The factory is of mill construction, and contains 72,000 square feet of floor space, having three stories and a basement. An admirably equipped shop and excellent railroad facilities will enable the company to handle its large business with ease.

CHAS. A. SCHIEREN & CO., 45, 47, 49, 51 Ferry street, corner Cliff street, New York city, have recently received orders for the following: Two 46" three-ply belts, each about 110 feet long, and about twenty-four dynamo belts for the Citizens' Electric Illuminating Company, DeKalb ave. and Rockwell Place, Brooklyn, N .Y.; 48" three-ply belt, and some other belts, for the Capital City, Gas and Electrical Company, Des Moines, Ia.; four 36" double belts, for the Union Light and Power Company, Nashville, Tenn.

THE VIADUCT MANUFACTURING COMPANY have established their works temporarily in Baltimore. The great fire which occurred on the night of June 30 swept everything of that extensive plant away, not leaving a screw driver. On July 30, in just 30 days, the company had an engine running in a building rented for the purpose, and are now turning out their specialties, viz., telephones, magneto bells, district telegraph boxes, etc., and after a few days there will be very little delay in filling orders promptly.

QUEEN & CO., INCORPORATED, of Philadelphia, Pa., owing to the depression during the last year and the difficulty in making collections, have been compelled, in the interest of all their creditors, to make an assignment, without preference, to their present manager, Mr. John G. Gray. A meeting of the creditors for the purpose of determining the best method of disposing of the assets of the company will be held at the office of the attorneys for the assignee, Messrs. Jones & Carson, Rooms 426-431, Drexel Building, Philadelphia, on August 13, at 2 o'clock p. m.

MANNING, MAXWELL & MOORE, 111 and 113 Liberty street, New York city, have just received the following orders for the well-known Shaw three-motor electric traveling cranes, built by The Shaw Electric Crane Company, Muskegon, Mich., for whom they are the sole agents: Pittsburgh Tin Plate Works, a 12-ton crane; Henry R. Worthington, New York, a 30-ton crane; The Midvale Steel Company, Nicetown, Philadelphia, a 40-ton double trolley crane. The crane to the Worthington Pump Works is to supplement an electric crane of another make. The order from the Midvale Steel Company is especially satisfactory, in view of the fact that they now have in their works one 80-ton, two 40-ton and two 20-ton Shaw electric cranes.

FAN MOTOR TESTS.—We have received from the Interior Conduit and Insulation Company, 42-44 Broad street, New York, the results of some fan motor tests made at the company's factory, 537 West Thirty-fourth street, on July 16. Three machines were tested and 12 readings were taken of each machine in order to secure a proper average. The mean of the 12 readings with machine No. 560 gave a speed of 1,732 and 114.96 volts and .448 ampere. The second machine, No. 562, at a speed of 1,422, took 114.7 volts and .8425 ampere. This is also the mean of 12 readings. The twelve tests of machine No. 568 show that at a speed of 116.16 it required 114.89 volts and one ampere. The motors were selected at random from stock, and the results are certainly very flattering.

THE BALL ENGINE COMPANY'S shops at Erie, Pa., present a scene of activity in spite of the unfavorable condition of trade generally and are running full time. There have been shipped from the works lately the following engines: Edison Electric Light and Power Company, Erie, Pa., one 350-h. p. vertical compound; Edison Electric Light and Power Company, Erie, Pa., one 300-h. p. cross compound; Eureka Light Company, Eureka, Cal., one 300-h. p.; Industrial Home of the Blind, Chicago, one 80-h. p.; J. H. Houghton, Boston, Mass., one 50-h. p.; Minneapolis General Electric Company, Minneapolis, Minn., one 35-h. p.; Bronx Gas and Electric Light Company, Van Nest, N. Y., one 250-h. p. tandem compound; Hotel Newcombe, Quincy, Ill., one 60-h. p.; Gen. A. S. Bushnell Building, Springfield, O., one 60-h. p.; Lexington Electric Light Company, Lexington, N. C., one 50-h. p.; Greenwich Gas and Electric Light Company, Greenwich, Conn., one 150-h. p.; Greenwich Gas and Electric Light Company, Greenwich, Conn., one 125-h. p.; Kennard House Company, Cleveland, O., one 50-h. p.; City of Griffin, Ga., one 135-h. p.; Howe Pump and Engine Company, Ladd, Ill., one 50-h. p.; Sykes & Wagner, Minneapolis, Minn., one 30-h. p.; F. F. Vater & Co., Minneapolis, Minn., one 35-h. p.; Risdon Iron Works, San Francisco, Cal., one 150-h. p.; Electric Supply and Engineering Company, Detroit, Mich., one 70-h. p.

THE HAWLEY DOWN DRAFT FURNACE COMPANY, Chicago, Ill., is always to the front with its well-known system of down draft. In this furnace there are two separate grates, one above the other. The upper one is formed of a series of tubes opening at their ends into steel drums, or headers, which in turn are connected with the boiler, through which the boiler water continually and rapidly circulates. It is this upper grate only which is fired, and the down draft of air being passed from the upper fire doors, the gaseous matter from the green coal consumed on the upper water tube grates is passed right through this mass of fuel. Whatever gases escape unconsumed are then burnt by the flame from the lower grate. The lower grate, formed of common bars, is entirely fed by the half-consumed fuel falling from the upper grate, and as the flame from this source ascends, it meets the downward burning fire from the upper grate, and the joint draught current passes through the flues in the usual way. The water tubes and connections give much additional heating surface. This system is in use in some of the largest plants in the country, and the company has received most flattering testimonials as to its efficiency and economy.

THE OHIO BRASS COMPANY reports orders of considerable size during the month of July for its Type W. material from the following roads: Middletown and Goshen Traction Company, Middletown, N. Y.; The Elyria-Lorain Electric Railway Company, Lorain, O.; The Consolidated Street Railway Company, Toledo, O.; The Cincinnati Street Railway Company, Cincinnati, O.; The Toledo and Maumee Railway Company, Toledo, O.; Keokuk E. L. and Power Company, Keokuk, Ia.; Des Moines Railway Company, Des Moines, Ia.; East Liverpool and Wellsville Railway Company, East Liverpool, O.; Beaver Valley Traction Company, Beaver Falls, Pa.; Lake Cities Electric Railway Company, Michigan City, Ind.; Consumers' Electric Light and Street Railway, Tampa, Fla.; Citizens' Street Railway Company, Memphis, Tenn.; Fort Wayne Electric Railway Company, Fort Wayne, Ind.; Warren Street Railway Company, Warren, Pa.; The Chillicothe Electric Railway Company, Chillicothe, O.; The Akron Street Railway Company, Akron, O.; Punxsutawney Passenger Railway Company, Punxsutawney, Pa.; Union Street Railway Company, Saginaw, Mich.; West End Street Railway Company, Knoxville, Tenn.; Riverside Park Street Railway Company, Saginaw, Mich.; Brightwood Railway Company, Washington, D. C.; Nashville Traction Company, Nashville, Tenn.; The Delaware Electric Railway Company, Delaware, O.; The Marion Street Railway Company, Marion, O.; West End and Riverside Electric Railway Company, Montgomery, Ala.; The Columbus Street Railway Company, Columbus, O.; The Lansing City Electric Railway Company, Lansing, Mich.

THE BROOKLYN ELECTRIC MANUFACTURING COMPANY, of 286 Graham street, Brooklyn, N. Y., suffered a partial loss by fire on the evening of July 7 last. The machinery and full stock of switches were entirely destroyed, as were also the patterns. There was a loss of 5,000 pounds of raw material, the copper and brass being rendered useless by the intense heat. The total loss was about $9,000, insured for $15,000. By reason of the insolvency of one of the insurance companies only $5,000 will be recovered. On the 15th of July the company moved to the commodious building 351 Jay street, where it occupies 100x50 feet on the second floor. The company has put in new machinery of the latest design and has larger and better facilities than ever for the manufacture of its well-known switches. This company has had all it could do during the past year and at present is as busy as ever, as is evidenced by the following orders recently taken: A large switchboard for Hotel Gerard New York, containing two 750 ampere switches, and one main double throw switch of 1,500 amperes capacity; ten 150 ampere, three-pole switches; four 150 ampere, two-pole switches; ten 50 ampere, three-pole, switches; four 50 ampere, two-pole switches; three 200 ampere, two-pole switches; one 200 ampere, three-pole switch; 4 ammeters, 2 voltmeters, 3 rheostats. Another large board is being built by this company for the Academy of Music Brooklyn, which will contain 39 switches mounted on Tennessee marble and have all the latest devices. An order for four 1,000 ampere three-pole double-throw switches comes from

the Edison Illuminating Company, of Brooklyn. A large board has also just been finished for Hotel Majestic, New York city.

THE WILSON-WHITING-DAVIS OILING COMPANY, of New York City, held its first directors' meeting in Jersey City, August 2, 1894, and elected the following officers: Wm. Wilson, Jr., New York, president; Morton E. Davis, New York, first vice-president; Jos. M. Wilson, New York, second vice-president; C. H. Wilson, New York, treasurer; Louis A. Chandler, secretary and assistant treasurer; directors, W. I. Allen, assistant general manager Chicago, R. I. & Pacific Railway Company, Chicago; R. B. Campbell, general manager B. & O. Railway Company, Baltimore, Md.; J. G. Hartigan, assistant general superintendent Illinois Central Railway, Chicago; Chas. M. Linington, merchant, Chicago; Thos. E. Gooch, civil engineer, New York; Wm. Wilson, Jr., merchant, Washington, Ia.; J. R. Young, cashier Washington National Bank, Washington, Ia.; P. S. Whiting, electrician, Des Moines, Ia.; Louis A. Chandler, attorney-at-law, New York; Morton E. Davis, New York; Geo. F. Wilson, general superintendent of motive power Chicago, R. I. & Pacific Railway, Chicago. Morton E. Davis was elected general manager of the company. Mr. Davis has appointed P. S. Whiting his assistant manager, with headquarters at Chicago; J. M. Wilson, superintendent of construction Western territory, Chicago; J. K. Tremaine, superintendent of construction Eastern territory, New York. The company has opened offices at Des Moines, Ia., and Denver, Col. Messrs. E. Waterman and Oscar Lofquist are general Western agents, with headquarters at Des Moines, Ia. Albert Blanchard is the Chicago agent; Armstrong, Palmer & Armstrong are the Denver agents; J. H. Ackroid, Philadelphia agent; T. E. Gooch, New York agent. The company has also opened in London, England. P. S. Whiting is the inventor of the system. The company is organized under the State laws of New Jersey, with a capital stock of $200,000.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 7, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

523,986. PROCESS OF ELECTRIC METAL WORKING: Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass. Application filed October 20, 1890. A method of correcting the tendency to localization of effect from two electric currents made to flow through the same medium, consisting in producing alternations of each current differing in phase approximately ninety degrees.

523,987. ELECTRIC WELDING MACHINE; H. Lemp, Lynn, Mass. Application filed January 19, 1891. In an electric welding or metal working machine, the combination with the transformer secondary, of plates, one located on each terminal of said secondary and provided with intersecting work holder chocking grooves, and universal work holders adjustable laterally and longitudinally thereon.

523,995. ELECTRICAL MOTOR; H. B. Porter, New York, N. Y. Application filed December 5, 1893. In combination with rotating shaft and a pair of electrical motors provided with reciprocating rods operated thereby and connected with said shaft through the medium of a crank arm thereon, of a movable sleeve on said shaft, having its surface divided into sections of conducting and non-conducting material substantially as set forth, and means for engaging and adjusting said sleeve on its shaft. (See illustration.)

523,998. DYNAMO-ELECTRIC MACHINE; Gustaf Rennerfelt, Lynn, Mass. Application filed March 6, 1894. The combination of a magnet with a divided core, a series of rotating conductors interposed between the parts thereof, and means for electrically connecting said conductors in series. (See illustration.)

524,003. ELECTRIC ARC LAMP; G. G. Stout, Parkersburg, W. Va. Application filed June 19, 1894. An inclosure for the carbons of an electric arc lamp, consisting of a stationary tubular section of transparent material, a tubular section detachably connected thereto by means of a suitable coupling, and a tubular section slidable thereon, and a tapering tubular coupling for holding suspended the slidable section.

524,009. TELEPHONE ANNUNCIATOR AND CALL BELL; F. G. Warrell, Philadelphia, Pa. Application filed June 25, 1891. An annunciator, call bell, wiring connections, ground wires, battery, push button, telephones, connected directly at each terminal with the call bell system of wiring, central telephone, provided at the annunciator, switchboard and switch connections connecting the central telephone with the switchboard, each telephone and push button of the series of telephone terminals and push buttons being connected by circuits with the annunciator and central telephone independent of each of the other respective terminals.

524,011. ELECTRIC MOTOR; F. C. Whitmore, Lynn, Mass. Application filed May 5, 1893. A multipolar motor, comprising an armature, a top and base consisting of box-shaped castings, with internal polar extensions secured together, and inclosing said armature, and wound field magnet cores supported between the side walls of said castings, the internal polar extensions forming consequent poles to said wound magnet cores.

524,014. TROLLEY WIRE SUPPORT; L. Yakel, Allegheny, Pa. Application filed April 15, 1893. In an electric insulator, the combination of a bolt, the lower end of which is adapted to be secured to a fin for an electric wire, a series of asbestos and mica discs alternately strung thereon, a ring, a cap adapted to be secured thereto and means of securing said bolt in said ring and cap.

524,017. TROLLEY FOR ELECTRIC CARS; G. C. Boudereaux, Peoria, Ill. Application filed March 12, 1894. In a trolley for electric cars, a fork constructed of two separable halves, having their free ends enlarged into the hollow heads, a bearing block retained in each of the said hollow heads and provided with a tapering depression for the reception of a shaft and a slot made at right angles to said depression.

524,020. DYNAMO-ELECTRIC MACHINE; Rudolf Eickemeyer, Yonkers, N. Y. Application filed October 7, 1891. In a dynamo-electric machine, the combination of an armature; separate electro-magnets each having its own field coil or coils, and having cheek pieces symmetrically arranged with relation to the armature, with each two similarly polarized cheeks separated by spaces parallel with the armature winding, and a counter field coil or coils, which either strengthen or weaken the magnetism of appropriate cheeks, according to the direction in which the machine is operated, for maintaining a permanent line of commutation, regardless of variations in speed or load.

524,028. CONDUIT ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. Application filed September 12, 1891. In an electric railway, the combination of a working conductor arranged along the railway, an electrically propelled vehicle having a pivoted four wheeled truck, and a current collector carried by said truck between its wheel base making contact with said working conductor. (See illustration.)

524,038. RAILWAY SIGNALING DEVICE; William Daves, Jersey City, N. J. Application filed August 3, 1892. In a railway electric signaling system adapted to be actuated by a moving train, the combination with two armature levers having a free movement to and from the pole of their magnets, a contact stop located in the path of the levers to close the circuit in the signal magnet, and means operated by the release of the first armature lever to remove the contact out of the path of the other.

524,044. ELECTRIC PUMP; F. W. Merritt and Arthur R. Roe, Duluth, Minn. Application filed November 6, 1893. The combination of a pump cylinder provided with a reciprocating piston, a bar armature attached directly to the piston rod and provided in the direction of its length with a number of coils, a commutator carried by said armature, and consisting of a series of insulated contact plates arranged parallel with the axis of the armature and connected with corresponding coils thereof, a series of field magnets of alternately opposite polarity arranged parallel with the movement of the armature, and a switch arranged to reverse the current through the field or armature coils at the end of each stroke of the armature.

524,062. ELECTRIC HEATER; J. F. Kester, La Grange, Ill. Application filed April 29, 1893. A heater, consisting of a slab of soapstone provided with a cavity, a resistance medium arranged in said cavity and an insulating filler composed of twenty-five parts of soapstone, twenty-five parts of flint glass, fifteen parts of carbonate of soda, ten parts of boracic acid and twenty-five parts of silicate of soda.

524,066. WATER-PROOF INSULATED ELECTRIC CONDUCTOR; Duncan McFarlan, Philadelphia, Pa. Application filed May 17, 1894. A water and fire-proof insulated electric conductor, having a thread or cord of fire-proof material saturated with a liquid insulating substance wound around the same and a water-proof sheet or strip surrounding said conductor.

524,098. ANNUNCIATOR; Phillip Weber, Nuremberg, Germany. Application filed January 16, 1894. An annunciator system in which the press buttons and magnets are divided into groups, a battery cell for each group, which cell has one terminal connected by a single wire with all the push buttons of the group, as many return wires connected with the push buttons as there are push buttons in one group, with which return wires the push buttons of the remaining group are also connected, each return wire being connected with one magnet of each group.

524,100. SUPPORTING INSULATOR FOR ELECTRIC WIRES; L. S. Beardsley, Naugatuck, Conn. Application filed June 11, 1894. A holder for insulators consisting of a pin provided with screw threads designed to engage the screw threads in the interior of a glass insulator, the pin having projecting therefrom a bolt, a bolster for the bolt, and means for securing the bolt in position.

524,109. ROSETTE FOR ELECTRIC LIGHT WIRES; C. N. Hammond, Boston Mass. Application filed December 7, 1893. A rosette for electric wires, comprising a base block, a hollow bulb, a removable fuse block and suitable contact pieces, said fuse block being provided with a fuse or fuses located on the opposite side of said block from the lamp cords, whereby when a fuse is burned the lamp cords are protected from injury.

524,116. ELECTRIC ARC LAMP; W. S. Pendleton, New York, N. Y. Application filed March 6, 1894. The combination of the magnet, the rocking frame carried thereby, the carbon carriage suspending wheel mounted in said frame, a coil spring applied thereto and tending normally to raise the carriage, a gear moving with said wheel and driving a pinion on a shaft mounted in the frame, a rachet wheel and a brake wheel carried at opposite ends of said shaft, the frame actuated by the magnet, the pawl on the frame engaging the rachet wheel, the brake shoe and the contacts for automatically opening the circuit of the magnet when it has caused the movement of its frame.

524,117. MOTOR SUSPENSION FOR RAILWAY WORK; E. W. Rice, Jr., Lynn, Mass. Application filed August 15, 1889. In an electric railway motor, the combination of a rigid supporting frame for the armature axis, consisting of two side pieces or bars sleeved at one end on the car axle and united at their opposite ends by a cross bar or piece integral with them, and a nose piece extending from the cross piece and free to slide on an elastically mounted bar or support. (See illustration.)

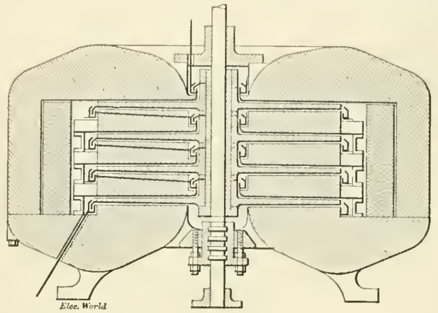
524,118. PRINTING TELEGRAPH INSTRUMENT; J. H. Rogers, Bladensburg Md. Application filed December 12, 1893. The combination with a printing mechanism of a reciprocatory paper carriage, a motor therefor, and an electro-magnetically controlled clutch for connecting the carriage to the motor.

524,119. DYNAMO-ELECTRIC MACHINE; W. B. Sayers, Glasgow, Scotland. Application filed January 6, 1894. A dynamo-electric machine, in which the sections of the armature winding are connected to the commutator strips by commutator coils, each of which is arranged approximately at right angles to the plane of the armature sections to which it is connected.

524,120. ELECTRIC HAND APPLIANCE FOR MASSAGE; A. J. Speare, Thayer, Mich. Application filed April 16, 1894. A holder plate having an adjustable hand hold, and a series of electrical conductors supported on the plate and having bared terminal ends adapted to contact with the fingers of a hand.

524,136. REGULATOR FOR DYNAMO-ELECTRIC MACHINES; T. A. Edison, Menlo Park, N. J. Application filed November 11, 1881. The combination with a dynamo-electric machine having its field circuit derived from the main or armature circuit, of an electro-magnet placed directly in the main circuit of such machine and a variable resistance placed directly in its field of force circuit, the magnet varying the resistance of the field circuit as the magnet is more or less energized. (See illustration.)

524,156. THERMO-ELECTRIC VOLATILIZING OBTUNDER; O. B. Bachman, Minneapolis, Minn. Application filed April 6, 1893. The combination in an



No. 523,998.—DYNAMO-ELECTRIC MACHINE.

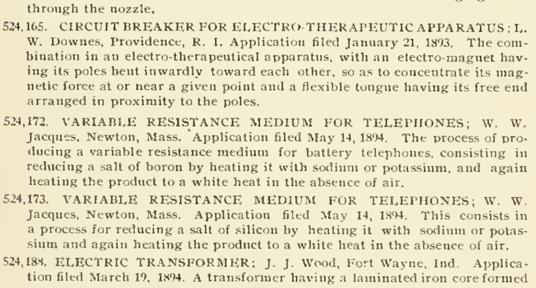
obtunder of an air or gas receiving chamber with a heater arranged therein, a discharge nozzle connected with the chamber, and means for charging the air or gas with an obtundent or anaesthetic before discharging same through the nozzle.

524,165. CIRCUIT BREAKER FOR ELECTRO-THERAPEUTIC APPARATUS; L. W. Downes, Providence, R. I. Application filed January 21, 1893. The combination in an electro-therapeutical apparatus, with an electro-magnet having its poles bent inwardly toward each other, so as to concentrate its magnetic force at or near a given point and a flexible tongue having its free end arranged in proximity to the poles.

524,172. VARIABLE RESISTANCE MEDIUM FOR TELEPHONES; W. W. Jacques, Newton, Mass. Application filed May 14, 1894. The process of producing a variable resistance medium for battery telephones, consisting in reducing a salt of boron by heating it with sodium or potassium, and again heating the product to a white heat in the absence of air.

524,173. VARIABLE RESISTANCE MEDIUM FOR TELEPHONES; W. W. Jacques, Newton, Mass. Application filed May 14, 1894. This consists in a process for reducing a salt of silicon by heating it with sodium or potassium and again heating the product to a white heat in the absence of air.

524,188. ELECTRIC TRANSFORMER; J. J. Wood, Fort Wayne, Ind. Application filed March 19, 1894. A transformer having a laminated iron core formed



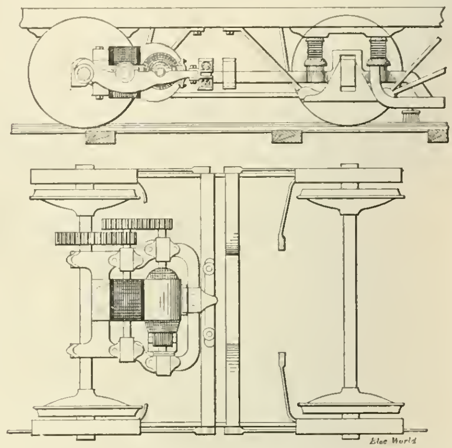
No. 524,025.—CONDUIT ELECTRIC RAILWAY.

with a ventilating space through it, maintained by means of a corrugated sheet interposed between the laminæ to hold them apart and forming air spaces in its corrugations.

524,202. ELECTRIC SIGNAL FOR STEAMBOATS; R. H. Gruschow, Chicago, Ill. Application filed January 30, 1894. In an electric signal the combination of a series of levers, each provided with an eye and carrying a visual signal, a magnet for each of the levers included in circuit with the battery and a circuit closer, and having its armature adapted to actuate the heel of the lever, an elevated bar common to all of the levers and arranged in the path of the same, and an alarm circuit including a local battery and an audible signal mechanism and having its conductors in electrical connection with the bar and the armatures of the electro-magnets.

524,229. PRIMARY BATTERY; W. Walker, Jr., Birmingham; F. R. Wilkins, Handsworth, and J. Long, Smethwick, England. Application filed February 27 1894. A single liquid primary voltaic battery, consisting essentially of a perforated glazed earthenware jar and a porous cell of much smaller diameter than and situated concentrically in the perforated earthenware vessel for containing the electrolyte in which the zinc or positive element is suspended, the space between them being filled with powdered carbon in which one, two, or more plates or rods of solid carbon are inserted, the heads or tops of which are in electrical contact with each other.

524,232. INSULATING TROLLEY WIRE SUPPORT; F. M. Zimmerman, Detroit, Mich. Application filed November 2, 1893. This consists of the combination of an outer shell, a central screw-threaded nut secured to but spaced

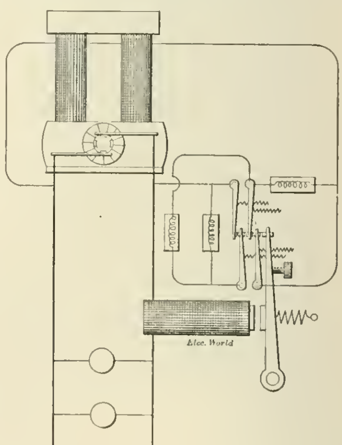


No. 524,117.—MOTOR SUSPENSION FOR RAILWAY WORK.

from the shell by an insulating disc, a supporting stirrup engaging the nut and a saddle piece adapted to form a grip therewith.

524,239. SUBMARINE SIGNALING; L. I. Blake, Lawrence, Kan. Application filed December 22, 1893. This system of signaling between an anchored lightship and the shore comprises the combination of telephonic or telegraphic signaling instruments and batteries on the ship and shore respectively, an insulated cable extending from the shore station to the ship's anchor with which the core of the cable is electrically connected, a conducting anchor chain and a circuit on the ship from the chain to a submerged metallic plate, the circuit including the signaling instruments on the ship.

524,282. ELECTRIC RAILWAY POLE RATCHET; J. J. McTighe, New York. Application filed January 23, 1893. A metallic pole ratchet in combination



No. 524,136.—REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

with a metallic clamping device for attachment to the pole and insulation electrically separating the ratchet from the clamping device.

524,283. TROLLEY WIRE CIRCUIT BREAKER; T. J. McTighe and S. W. Childs, New York. A trolley wire circuit breaker composed of two end castings united by two parallel insulated rods fixed in these castings but insulated therefrom.

524,291. PRIMARY VOLTAIC BATTERY; W. Walker, Jr., Birmingham, and F. R. Wilkins, Handsworth, Smethwick, England. Application filed June 4, 1894. A single liquid primary voltaic battery, consisting of a porous cell containing the exciting liquid in which the zinc or positive element of the battery is suspended, the other or negative element carbon in the form of powder and coarse grains being retained in position around the outside of the porous cell by means of a wire gauze casing.

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CONTENTS.

THE OLD AND THE NEW.

The Marquis of Salisbury in his presidential address before the British Association at Oxford illustrated the past and present relations of Oxford University toward modern science by comparing the warm reception of the Association in the present year with the one it experienced at its first meeting in the university town, in 1832. Then there was an entire lack of sympathy, and even the gentle spirit of Dr. Keble, the leader of thought in the university, was sorely vexed at the bestowal of the honorary degree of D. C. L. on four members of the Association, and he indignantly complained that the "Oxford doctors have truckled sadly to the spirit of the times in receiving the hodge-podge philosophers as they did"—the "hodge-podge" philosophers being Faraday, Brewster, Dalton and Brown! The same spirit had not yet departed in 1860, at the last previous meeting of the Association in Oxford, but this time it was the scientists who adopted the superior tone and were active aggressors. At the meeting just closed the relations of the old antagonists, according to the Marquis of Salisbury, were "those of entire sympathy and good will, as becomes common workers in the sacred cause of diffusing enlightenment and knowledge."

ELECTRICAL SYMBOLS, ABBREVIATIONS AND UNITS.

As a useful reference table we reprint elsewhere the symbols, notation and abbreviations recommended for international practical use by the Committee on Notation of the Chicago International Electrical Congress, and ordered printed as an appendix to the general report of the Chamber of Delegates; to which has been added, in italics, the names of the provisional practical magnetic units adopted by the American Institute of Electrical Engineers. The value of uniformity in notation, symbols and nomenclature is so obvious to all that it is needless to dwell upon it, and it is not too much to say that even a very imperfect system would be much better than none at all. That of Professor Hospitalier is the result of years of study and criticism, and, as will be noted, introduces few, if any, radical changes from the usage of the best writers of all countries. While some points may possibly be open to criticism from a special point of view, investigation in regard to these would in every case, we think we can say with assurance, develop sufficient reasons for their justification. It should be borne in mind that such a system, devised for use in all languages and for general application, cannot reasonably be expected to exactly satisfy the conditions of theoretical perfection for every case that may come under it. In the present instance the compromises have been made by one eminently qualified, from his practical and theoretical attainments, judicial temperament and cosmopolitan breadth of view, to weigh all of the considerations involved. The table as finally presented to the Congress only received its definitative form after some years of criticism invited from international sources, and therefore may safely be accepted as possessing in the highest degree possible the requisites necessary for general and international use. The favorable reception which the new magnetic units have received renders it extremely probable that the next international electrical congress will give its official assent to the names adopted, as the recent one did to the henry. Like the henry, too, they are of American origin, and while science knows no country, yet this fact offers an additional argument why American electricians should receive them with favor. Once thoroughly established in this country they cannot be disregarded by the electricians of other countries, though it may be remarked, no evidence of disfavor has been manifested abroad, but, on the contrary, the comments have shown the opposite spirit.

ECONOMIC AGE OF INCANDESCENT LAMPS.

Under the above caption the Digest gives an abstract of a recent article in L'Industrie Electrique on the "smashing point" of incandescent lamps. We cannot at all agree with the statement that it requires an experienced eye to detect a drop of 20 per cent. in the candle power of a lamp; if the filament is at a very high degree of incandescence when new—that is, if the lamp is one of high efficiency—the drop is more difficult to detect, as the "fatness" of the filament is not as much decreased, but even in this case a user in time would easily recognize the difference. It is well to point out that the calculations for the "smashing point" of a lamp rest upon the assumption of a necessity for a constant intensity of illumination. This is a condition that is ordinarily not demanded, as usually a diminution in the intensity of a considerable amount will have little practical importance. To be sure, as lamps age the illumination will diminish, but as long as it remains sufficient there would be no economy in "smashing lamps," particularly as the current is also reduced, though not in as great a proportion as the light. A question of prime importance, however, in the economical use of lamps, is that relating to the efficiency at which they should be used, or, in other words, the intensity of the incandescence of the filament. The higher this incandescence is carried the shorter will be the life, but, on the other hand, the lesser the energy will be for a given quantity of light. The factors that enter into the question of efficiency are the cost of the lamp and of the electrical energy used, and the rate of variation of the candle-power with the watts supplied to the lamp and with the life of the lamp. Of these factors the first two are, of course, known in every case; the third is well established, and the fourth has been determined by some lamp manufacturers. A practical method of arriving at a solution would be to raise or lower the voltage, where this is practical, of the circuit without varying the voltage of the lamps, or by varying the voltage of the lamps, that of the circuit remaining constant. By noting the effect on the total cost for illumination, the most economical age might thus be determined. In general it may be said that where the power is expensive, lamps may be used considerably above their normal voltage with economy, and vice versa. The former is the condition where current is taken from a central station, and it would be worth the while of consumers thus supplied to experiment with lamps somewhat below the voltage of the circuit, and note if the lower meter bill will not more than compensate for increased breakages. Where, however, electric power is cheap, as in isolated plants, it will be best to buy lamps of a voltage higher than that of the circuit, and thus insure a longer life. One engineer of whom we know recommends for this case the purchase of 20 candle-power lamps of several volts above that of the circuit, the candle-power thus being reduced to about 16. It will be seen that the life of a lamp is far from being the controlling factor in the question of economy; for every set of conditions there is a definite life, and if this is prolonged by the filament being used at a less incandescence than corresponds to this condition, there is a loss which becomes greater the longer the life. Therefore, instead of being satisfied with lamps having a long life, the contrary should be the case. Central station managers have an additional interest to promote this efficient condition, for the sickly light given out by aged lamps is not apt to increase confidence in electric lighting.

ENGINEERING EDUCATION.

The address of Prof. Kennedy before the Mechanical Science Section of the B. A., on "The Critical Side of Mechanical Training" is of especial value at the present time when there seems to exist so much difference of opinion in regard to the methods of technical education. His definition of an engineer and enumeration of the nature of the duties he is called upon to perform are so apt that we quote the entire passage, which is the key-note of the address: "An engineer is a man who is continually being called upon to "make up his mind. It may be only as to the size of a "bolt; it may be as to the type of a Forth bridge; may "be as to the method of lighting a city; or only as to the "details of a fire-grate. But, whatever it is, once it is settled it is "decided irrevocably—it is translated into steel and iron and copper, "and cannot be revoked by an act passed in another session. The "time given him in which to decide may be a day or a month, "or year, but in any and every case (so far as my own experience "goes) it is about one-tenth part of the time which he would like "to have. It is only in rare cases that the decision is obvious—most "often there are courses more open than even the most facile politi-"cian ever dreamt of. The matters are too complex to be dealt "with mathematically or even physically; even if they were not, "there are few engineers who would have the special capacity to "handle them. Moreover, their solutions are seldom "unique." "From this point of view, the whole use of college training, of "workshop practice, of practical experience, is to provide the "engineer later on with the means of critically examining each "question as it comes up, of reviewing systematically the *pros* and "*cons* of each method of dealing with it, of coming finally, "rapidly and positively to some defensible decision, which "may then be irrevocably carried out." Stress is laid upon the desirability of imparting to engineering students the power of literary expression, and regret expressed that so little attention has been given to this point. Some of our American technical schools are particularly deficient in this respect, and we recall the statement of an eminent engineer that he could always recognize from the illiteracy of their writings the graduates of a certain well-known technical school. It is pointed out that the power of expression carries with it the idea of clearness and consecutiveness of thought, so that, in this broader sense, the matter involves more than the teaching of literary style, and is also connected with the development of the fundamental sense of proportion, upon which stress is laid throughout the paper. Prof. Kennedy draws a distinction between physical and engineering laboratories in the statement that the aim in the former is to make all problems as simple as possible, to eliminate all disturbing influences or elements, and to obtain finally a result which possesses the highest degree of accuracy. The business of the engineer, on the other hand, is to deal with physical problems under conditions that he can only partially control, and which are a part of his problem. The work in the engineering laboratory, therefore, should be in quantitative and relative measurements, rather than in absolute ones, and made to a great extent with the complicated conditions present under which the actual final result has to be obtained. The question as to whether there is any general standpoint from which mechanical criticism may be directed is shown to be so involved as to admit of no perfectly general answer, but as a near approach Prof. Kennedy offers a criterion to apply to any scheme, system or machine, which is that the absolutely best in any particular case is that which will longest survive and maintan its place in its particular environment. The views of Prof. Kennedy on engineering education may be resumed in the statement that it should consist most largely in the development of the judgment, and therefore problems should be studied under the complex conditions met with in practical work and not divorced, for the sake of more absolute accuracy, from these conditions. How much of mathematics and pure physics should be taught and in what manner, are subjects which are not taken up except to point out that the attitude of mathematicians and physicists in demanding that these branches shall be exhaustively taught is unreasonable, as their importance in an engineering course must be rated by an engineering and not purely scientific standard.

High vs. Low Tension.

In Germany recently one man was killed and another injured by an electric current, the latter being awarded damages while the former was not; this would appear to be an argument, at least in Germany, for the use of high tension circuits, as it appears to be cheaper for the companies to kill outright than to injure persons.

Annual Meeting of the American Association for the Advancement of Science

The opening sessions of the forty-third meeting of the American Association for the Advancement of Science were held last week, beginning on Thursday, August 16, at the Polytechnic and Packer Institutes in Brooklyn.

The opening exercises were held in the chapel of the Polytechnic. William Harkness, the retiring president, called the meeting to order and introduced Dr. Daniel G. Brinton, the president-elect.

Dr. Truman J. Backus, president of the Packer Institute, delivered the address of welcome, in the absence of the Mayor, and dwelt particularly on the educational features of Brooklyn. President Brinton replied in a happy vein.

After the general session the several sections met and organized by the election of officers and committees. Three out of the nine vice-presidents elected at Madison last year were absent, and their places were filled by electing Edgar Frisbie in section A (astronomy and mathematics), J. H. Lintner in section F (zoology), and C. I. Bessey in section G (botany).

The addresses of the several vice-presidents occupied the afternoon. Eight in all were delivered, two of the absentees having sent on their manuscripts. Section A had a valuable paper from George C. Comstock on "Binary Stars,' in which he gave the latest results of his own and others' investigations and computations in this very important and progressive department.

Vice-President William A. Rogers read before Section B (physics), an address on "Obscure Heat as an Agent in Producing the Expansion of Metals Under Air Contact," giving an exhaustive demonstration of a subject which he is peculiarly qualified to discuss.

Pres. D. G. Brinton.

Thomas H. Norton addressed Section C (chemistry), on "The Battle With Fire." The loss of insured property, he states, is $200,000,000 annually, of which nearly one-half occurs in the United States, amounting to one fifth of all the net profits of the industries of the country. Eighty or ninety per cent. of the 15,000 annual fires in the United States are due to preventable causes, mostly faults in the construction of buildings. The fire department of London costs but one-third as much as that of New York. Preventive measures were recommended, calling in the activity of the chemist, notably in the way of apparatus and equipment for supplying carbon dioxide. Silicious paint was also recommended. The increased use of aluminum instead of wood wherever practicable in building was another preventive measure commended.

Vice-President Mansfield Merriman delivered a very able address before Section D (mechanical science and engineering), on "Paradoxes in the Resistance of Materials."

Vice-President Samuel Calvin's address to Section E (geology and geography), was on "Some Points in Geological History Illustrated in Northeastern Iowa." He dwelt upon the Niobrara chalk deposits, and exhibited what seems a novelty, genuine American chalk of commercial value.

Lucien M. Underwood sent to Section G an address on the "Evolution of the Hepaticae," a subject which he has made a specialty.

The antnropological address by Franz Boas, as usual, aroused popular interest. He spoke on "Human Faculty as Determined by Race."

Henry Farquhar read to the Economic Section (I) a very exhaustive treatise on "A Stable Monetary Standard."

In the evening the retiring President, Prof. Harkness, delivered his annual address in the Academy of Music, on the "Magnitude of the Solar System." He expressed the opinion that recent improvements in telescopes have added but little to the accuracy of measurements of solar parallax, and that the various other methods of determining the sun's distance were nearly as effective early in the century as they now are. A mass of observations has already accumulated, which, by careful calculation and compilation, comparing the results of different methods, will give a nearer approximation to the truth than any one observer could reach by unaided observation with the more refined instruments.

A very brilliant reception in the Art Building followed the evening address. The Ladies' Reception Committee had provided beautiful decorations, and the Entertainment Committee an elegant lunch.

Friday was devoted to the reading of papers in the nine sections, eighty-eight papers having been put upon the programme. In the evening Paul B. Du Chaillu lectured on "The Viking Age." The work of sections A, B and D is given in abstract below.

It is not alone the younger members of the association, on pleasure bent, who hail with delight the relief of Saturday's excursions in place of the formal sessions. The field meetings prove interesting and instructive to all by bringing them into closest communion with nature. Four different steamers conveyed the scientists in different directions. One, carrying the largest party, went to Cold Springs, whence the geologists took boats to Great Neck to study the folded clay beds of the tertiary age, which are unusually fine there; the biologists went by steam launch to the biological laboratory and fish hatching station, and the botanists tramped through the forests in search of specimens. The chemists embarked for the Standard Oil Works at Bayonne, N. J., and Balbach's Smelting Works and Feigenspan's Brewery at Newark. The United States government furnished the steamer Fish Hawk for a dredging excursion, and a small party boarded her at Tompkinsville, S. I., and steamed out to the Cholera Banks. The entertainment of the day, however, was the excursion to Long Branch. Two or three hundred members of the association, and invited guests, taking the steamer Aurora at Fulton Ferry, were conveyed to Battery Pier, thence by the "Mary Patten" to Pleasure Bay, and thence to the residence of Mrs. Esther Herrman at West End, where a bountiful lunch was provided. The surprise of the day, however, was when souvenirs of solid sterling silver designed by Mrs. Herrman herself were given the guests, consisting of badges, shaped like a scallop shell upon sea weeds, surmounted by the legend "Progress," with the lamp of science above all. The badge was lettered in blue "A. A. A. S., 1894."

Section A—Mathematics and Astronomy.

Mr. Geo. E. Hale opened the proceedings in this section by his interesting paper on "Some Attempts to Photograph the Solar Corona Without an Eclipse." Hale first failed from the great direct effects of diffused light, but decided to try again on Pike's Peak. In his ascent he found that the sky increased in depth of blue very perceptibly as the altitude increased. The advantage of elevation was very evident. But before he could get ready to try, great forest fires filled the atmosphere so as to spoil the favorable conditions, but at least he had the great satisfaction of getting no false corona, as all others had done. It was then suggested to try on Mt. Etna where there was already a telescope mounted. The apparatus was now much improved and tried on the moon, for parts of the moon are fully as bright as the corona. A semi-exposure of 40 seconds was used. But on Mt. Etna the driving clock stopped in a most exasperating manner in the midst of the exposures, and again the experiments were not successful. As a summing up of all, it can only be said "that the apparatus has not had a fair trial."

Mr. G. W. Hough then presented again a method of control of the Equatorial driving clock, which was published in the transactions of the Albany Institute in 1871. Mr. Clark rose to say that it had been used in Harvard for ten years and he supposed it to be

due to his own brother or to Pickering. Where this method is applied a clock will go all night without variation, and will watch the telescope better than the observer himself.

Next, W. R. Warner, in his paper on "Requisites for Governing the Motion of Equatorial Telescopes," told of the differing resistance produced by weather oil or the lack of it, etc., which yet the clock must overcome and still run accurately. To do this there must be a large excess of power. The problem is difficult but can be solved. Prof. Young, of Princeton, makes the beat practically isocronous by a varying angle which leaves the length of the pendulum always practically the same. This is used in the new 26-inch glass of the Naval Observatory, and is so perfect that electric control is not needed except for photography. Another method is based on the principle of the tuning-fork, which vibrates in the same time whether the beat be long or short. What is needed is excess of power and a mechanism to absorb evenly this excess of power.

Prof. Doolittle exhibited a large diagram picturing the results of the recent latitude determinations at the Sayre Observatory, of South Bethlehem, Pa. The Chandler theory and these observations differ so much that one can hardly be called an approximation of the other. Prof. Doolittle finds a diminution in the mean value of the latitude, which is entirely unaccounted for.

Mr. H. M. Parkhurst, on "Stellar Photometry," said that the two chief sources of error came from the difference in brightness of the evenings when the photographs are taken, and from the mis-identification of stars.

"An Extension of the Gaussian Potential Theory of Terrestrial Magnetism" was the subject of an interesting paper by L. A. Bauer. In the course of terrestrial magnetic investigations the question came up whether the potential of terrestrial magnetic force at the earth's surface could be derived, according to the Gaussian potential theory of terrestrial magnetism, for epochs where force observations are wanting and but observations of declination or of inclination or of both were at hand. If this potential could be derived say for epochs 1,600, 1,700, etc., up to the present time, a secular variation term might be introduced in the Gaussian potential expression and thus an expression obtained which would permit the drawing of approximate magnetic charts for any time during the interval for which the formula had been established, and various other interesting questions answered, as e. g.: What is the orbit described by the magnetic pole in the course of centuries? As the poles are the points of the earth's surface where the potential world has a maximum or a minimum value, by subjecting the potential to this condition the points might be located for any particular epoch. The question above has been partially investigated and affirmatively answered. A mathematical demonstration was then presented. How practicable the method is can only be determined by trial The trial can, however, not be made at present for want of force and time. The sole purpose has been to show that theoretically the solution of the question propounded above is possible.

Section B.—Physics.

In this section the first paper presented was by Prof. W. S. Stevens, in which he developed further a new mode of steroscopy, employing a pair of perfectly similar diagrams, of which the binocular combination is made to appear convex or concave at will by verging the relation between the visual lines and the planes of the two halves of the stereoscope to be exhibited.

A paper by A. Springer, of Cincinnati, on "Aluminium Violins" was next read. The quality of the tone is different according to whether the back and belly of the instrument are strengthened by arching and ribbing.

W. Hallock, of Columbia College, read a paper in which he showed that a photographic record of the behavior of manometric, or other jumping flames, is obtained by rotating the whole camera—an entirely new method.

A paper by Prof. E. L. Nichols on "A New Form of Spectrophotometer" described an instrument to compare two sources of light by comparison of spectra.

"The Thermal Conductility of Cast Iron," was considered in a paper by J. T. Osmond. He found the conductivity to be greater the higher the temperature. Forbes' method was used, but the results were notable as being the reverse of Forbes' for wrought iron.

A paper by R. W. Quick and B. S. Lamphear took up the "Normal Conductivity of Copper at Low Temperature." The Forbes method was employed. The conductivity was found to decrease as the temperature decreased.

Mary C. Noyes considered "The Influence of Heat and Electricity Upon Young's Modulus for a Piano Wire." The work was done in the Physical Laboratory of Cornell University under the direction of Prof. Nichols. The wire was heated by a current sent through a magnetizing coil surrounding the wire, thence though a non-inductive coil, and then through the wire itself. There was no effect from magnetization. Passing the current through caused the modulus to become larger. but the effect was irregular.

The next paper was by Prof. E. L. Nichols and Mary C. Spencer on "The Influence of Temperature Upon the Transparency of Solutions." The instrument used was the horizontal slit photometer and the source of light two incandescent lamps, the light coming from one direct and from the other through the solution. The solution was heated by an electric current. Different wave lenghts were compared at different temperatures with the following results: (1) In the case of water up to 80 deg. C. there was produced no change in the transparency for any portion of the visible spectrum. (2) Other solutions showed a diminution of transmitting power throughout the entire spectrum. (3) Certain solutions diminished for certain regions of the spectrum, but not for others.

Prof. Nichols and Mary L. Crehore in a paper on "Studies of the Lime Light" (presented also at the British Association this year) treated on the changes in the radiation in the tricad line cylinder of Drummond light from the moment of ignition to the final state of incandescence a spectro-photometer was used.

"On the Directed Velocity of the Particles in the Electric Arc," was the title of an interesting paper by Prof. B. W. Snow, of the University of Madison. The plan followed in this determination consisted of projecting on the slit of a spectrometer the image of the arc, viewed end on, and of observing any displacement of the spectral lines due to the motion in the line of sight. To accomplish this end two carbons were bored out longitudinally, these placed horizontally in line with each other, and connected with an alternating electric light circuit. In the core of the carbon farthest removed from the spectrometer was laid a piece of iron wire, which volatilized and filled the arc with iron vapor and yielded a brilliant iron spectrum. The light from this arc, passing through the hollow core of the nearer carbon, was projected upon the spectrometer slit. The luminous spot thus formed, consisted, therefore, of intermittent flashes produced as the discharge in the arc approached the instrument or receded from it. The light entering the slit was studied in the spectrum of the third order produced by a grating of 14,000 lines to the inch. It was expected that if the gaseous particles in the arc had a directed velocity, the lines would have been displaced in opposite directions, as the discharge approached or receded, and therefore the lines would appear doubled or at least broadened. Although a displacement equal to the one-hundredth part of the distance between the D lines could have been detected, no trace of such doubling or broadening occurred, and the lines throughout the spectrum appeared perfectly sharp. Had the lines appeared double by this amount, the velocity of approach would have been not far from a mile per second. Inasmuch as no velocity of this amount was observed, it is believed the directed velocity of the particles in the arc to be less than one mile per second, and therefore the temperature of the arc cannot be calculated from the directed velocity of the particles.

Section D—Mechanical Science and Engineering.

The first paper was on the "Crank Curve," by Mr. J. H. Kinealy, secretary of the section. In this paper a simple graphical method was given for determining the velocity of the piston of a steam engine for a given position of the crank. A curve was constructed so that the ordinates measured between it and the crank circle were proportional to the velocity of the piston. Prof. Kinealy has named this curve "the Crank Curve" and has developed several interesting properties relating to it, such as a method of determining the point of the stroke at which the crank-pin and piston of an engine have the same velocity.

The next paper was on preliminary experiments on a new air pyrometer for measuring temperatures as high as the melting point of steel, by D. S. Jacobus. Experiments made at the Stevens Institute show that three pyrometers gave concordant results in measuring very high temperatures. The pyrometers were placed in a special furnace and were gradually brought to a maximum temperature and were held at this maximum temperature for several hours. This has been done a number of times, and the readings of the pyrometers were found to agree with each other, thus showing that concordant readings are given at extremely high temperatures, and that the pyrometers are unaffected by heat as high as the melting point of steel.

A second paper by Prof. Jacobus was on the "Precautions Necessary in the Use of Mercurial Thermometers in Determining the Amount of Super-heat in Steam." The method recommended for measuring super-heat was to read the thermometer when acted on by saturated steam at a given preasure and subtract this reading from the reading when the steam is super-heated. This method eliminates various errors such as that produced in not heating the mercury in the stem of the thermometer. The steam tables also give the temperatures measured by an air thermometer, and there is a correction which must be applied to reduce to readings by a mercury thermometer.

A third paper by Prof. Jacobus was on "Improvements in Methods of Testing Automatic Fire Sprinkler Heads." Automatic fire heads for extinguishing fires have now come into common use. In these a valve is opened automatically in case of fire by the belting of a fusible solder piece and the water from this valve extinguishes the fire. The method of making tests on such heads was described in detail. The tests now made are much more complete than the first tests, for the reason that, as time passed on, and the action of the sprinklers could be noted after several years of actual service, various defects were developed. The present tests are made to cover, as nearly as possible, all features where defects have been noticed, and for this reason the requirements of a successful head are much more severe than in the first test. The various causes of failure and the requirements of a successful head were fully described.

A paper by Prof. J. E. Denton was next read on the "Ratio of the Expansion of Steam in Multiple Expansion Marine Engines for Maximum Economy in Fast River Steamers." This paper demonstrated by numerical examples that in fast river steamers the use of the ratio expansion affording the least consumpton of steam per horse power requires a greater consumption of fuel for a given amount of transportation than the use of engines using lower ratios of expansion and consuming correspondingly greater amounts of fuel per horse power. A chart was exhibited showing the calculations in detail for a specific case.

Next followed a paper by Samuel Marsden on "Experiments on the Transverse Strength of Long-leaf Yellow Pine." The results of numerous experiments were presented. The conclusions derived from the experiments are that the breaking strength of the pieces from nine trees vary so that some results are twice as high as others. Experiments on similar pieces having the same number of layers to the inch, taken the same distance from the centre of the trees, show an increase ot strength of about 20 per cent. after being seasoned. As a rule the greater the number of layers to the inch the stronger the timber will be, no matter from which part of the tree it has been taken.

The last paper presented at the meeting was by Elmo G. Harris on "The Air Lift Pump." Elaborate mathematical deductions were presented which show that under the assumed conditions about one quarter of the energy applied to the air is lost on account of the flow of water backward past the air bubbles. The formula derived applies to pumps say five or six inches in diameter. In small pipes the bubbles may fill the pipes and act as pistons of air, and in this case there would be a greater efficiency, neglecting friction, than in the case of larger pipes.

Of the affiliated societies which have thus far met, the only one whose proceedings are of interest to the electrical public is the American Mathematical Society, which met on August 14 and 15. Dr. Emory McClintock presided. About thirty mathematicians from different parts of the country were present. Dr. McClintock, in his address, said that the name of the society had been changed from that of the New York Mathematical Society to the American Mathematical Society, and the change was a successful move. Some eminent mathematicians were now ready to join who would not join before. The society had been successful in bringing together the mathematicians of the country, and in encouraging original research, but it had not yet provided for the proper publication of papers presented to it. How to remedy this defect was being considered. The programme included papers by Dr. Emory McClintock, Profs. Alexander Macfarlane, Frank Morley, E. Hastings Moore, George Bruce Halsted, R. S. Woodward, V. Schlegel, Artemas Martin and Henry S. White.

Molecular Energy.

According to G. F. Fitzgerald, a hydrogen molecule moving with the velocity of light has an energy of less than half a millionth of an erg.

British Association Meeting at Oxford.

The meeting of the British Association at Oxford, as was stated last week in the cablegram from The Electrical World's special correspondent, was opened on Wednesday, August 8, and, as had been expected, the papers and discussion were of great interest. The meeting was formally opened by the address of its president, the Marquis of Salisbury. He referred to the ignorance from which we suffer from a scientific standpoint, and the mysteries which surround our investigations. This century has witnessed determined and often very successful attempts to penetrate the unknown, but with the result only to extend a little the boundaries of knowledge. The nature and origin of the elements is still an unsolved problem. Many brilliant scientists have attacked it, but our knowledge in this direction still remains almost where it was centuries ago. The ether, Lord Salisbury went on, was another thing which baffled scientists. He spoke of it as a half-discovered entity, believing it to be an exaggeration of our knowledge to call it a body, or even a substance. One of the most brilliant services of Maxwell was the discovery of the relation between the velocity of light and the electric impulse. Still, nothing is known of this all-pervading entity except that it can undulate, and even this function is performed in an unusual fashion. Instead of undulating backwards and forwards in the path of its own advance, ether undulates athwart the path of the wave's advance. The genius of Lord Kelvin has recently discovered what he terms a labile state of equilibrium in which a fluid that is infinite in its extent may exist, and may undulate in this eccentric fashion without outraging the laws of mathematics. However far this may go towards the solution of the problem, it still leaves our knowledge of ether in a very rudimentary condition.

Prof. Rucker delivered a very able presidential address to Section A. He first called attention to the spread of scientific education. This, he stated, was well illustrated by the fact that it is within about thirty years that mathematics and physics have been recognized as wide enough to require more than one teacher, the first professorship of natural philosophy being established at Owen's College, Manchester, in 1860. It is also only about a quarter of a century ago that the Clarendon Laboratory (in which some of the present meetings are being held), the first laboratory in England specially built and designed for the study of experimental physics, was erected. He emphasized the importance of investigation and research, and regretted its assignment to a secondary position in the popular mind. Oxford had happily established within the last year a research degree. After calling attention to the recent evidences of private munificence for the advancement of learning, and to the difficulties now encountered by scientific workers in securing the publication of their papers and books, Prof. Rucker proceeded to the main subject of his address—the practical and theoretical study of terrestrial magnetism. He first drew the attention of the section to the necessity for a full primary comparison between the standard magnetic instruments in the different observatories. In his investigations during the past ten years he found that instruments for measuring the declination and horizontal force are affected by errors far greater than the errors of observation, the discrepancies often being most startling. In the second place, if conclusions have to be drawn from the minor differences between measurements of secular or diurnal change made in the observatories, it is not only necessary to know whether the instruments are strictly comparable and constant, but observations must be reduced by the same method. It is well known that the average daily oscillations of the magnet are affected by the magnetic weather. Accordingly, arrangements have been made for the English magnetic observatories to determine the diurnal variations for particular days when there were no magnetic disturbances. Prof. Rucker also suggested that the Astronomer Royal and Prof. Mascart might agree in their choice of days for the calculations so that there might be an exact similarity of method between the English and French observatories. He also stated that co-operation in the institutions was essential, and hoped that in time a "British Magnetic Year Book" might be produced. He then discussed the modern theories

of the phenomenon, citing important observations made by different observers, considering local disturbances, etc. Two causes of regional and local disturbances have been suggested, viz., earth currents and the presence of visible or concealed magnetic rocks. The two theories are not mutually exclusive. Both causes of the observed effects may, and probably do, co-exist. With all reserves and a full consciousness that in such matters hypothesis differs but little from speculation, Prof. Rücker states that he believes that the theory of induced rock magnetism, as the main cause of the disturbance, has the greater weight of evidence in its favor. Granting this, the nature of the material still remains to be solved. Is it virgin iron or pure magnetic, or merely a magnetic rock? Another phenomenon on which more light is desirable, is the permanent magnetization of magnetic rocks.

A paper by Lord Kelvin and Alex. Galt was read before Section A on "Preliminary experiments for Comparing the Discharge of a Leyden Jar through Different Branches of a Divided Channel." In these experiments the metallic part of the discharge channel was divided between two lines of conducting metal, each consisting in part of a test-wire, the other parts of the two lines being wires of different shape, material and neighborhood, of which the qualities in respect to facility of discharge through them are to be compared.

When the two wires were of the same material and length, but of different diameters, the testing elongation showed, as was to be expected, that the test-wire in the branch containing the thicker wire was more heated than the test wire in the other branch. With wires of different non-magnetic material—for example, copper and platinoid—of the same length, but of very different diameters, so as to have the same resistances, the testing elongations were very nearly equal.

In one series of experiments the tested conductors were two bare copper wires, each 0.16 cm. diameter, 9 meters long, and resistance 0.085 ohms, which is very small in comparison with 12 ohms in each of the platinum test wires. One of the copper wires was coiled in a uniform helix of 40 turns on a glass tube of 7 cm. diameter. The length of the helix was 35 cm., and the distance from centre to centre of neighboring turns therefore 7-8 cm. The middle of the other copper wire was hung by silk thread from the ceiling, and the two halves passed down through the air to the points of junction in the circuit. The elongation of the test-wire in this channel was more than twice as much as that of the test-wire in the channel of which the helix was part.

One hundred and seventy-one varnished pieces of straight, soft iron wire were placed within the glass tube, which was as many as it could take. This made the testing elongation ten times as great in the other channel.

The last comparison was between iron wire and platinoid wire conductors. The length of each was 502.5 cm. The diameter of the iron wire was 0.034 cm., and its resistance 6.83 ohms. The diameter of the platinoid wire was 0.58 cm., and its resistance 6.82 ohms. Each of these wires was supported by a silk thread from the ceiling, attached to its middle. Fourteen experiments were made, seven with the test-wires interchanged relatively to the branches in which they were placed for the first seven. The mean elongation of the platinoid channel was 0.183, and in the iron channel 0.124, while the energy used was nearly equal. The conclusion that the heating effect in the test-wire in series with the platinoid wire is nearly one and a half times as great as that of the test-wire in series with the iron, is certainly interesting, not only in itself, but in relation to Prof. Oliver Lodge's exceedingly interesting and instructive experiments on alternative paths for the discharge of leyden-jars, described in his book on "Lightning Conductors and Lightning Guards," which were not decisive in showing any general superiority of copper over iron of the same steady ohmic resistance, but even showed in some cases a seeming superiority of the iron for efficiency in the discharge of a leyden-jar.

Prof. Arthur Schuster read a paper in Section A on "A Possible Explanation of the Secular Variation of Terrestrial Magnetism," based upon the assumption that interplanetary space is a conductor of electricity. If there is an appreciable conductivity, the magnetic system of the earth will, owing to its rotation, induce currents which will react on the earth in a two-fold manner. There will be, in the first place, a mechanical effect tending to increase the length of the day, and, secondly, a magnetic effect tending to displace the magnetic axis. The conclusions of Prof. Schuster are, first, that the mechanical reactions on the earth of currents induced in space, assumed to be a conductor of electricity, by the rotation of its magnetic system, are insufficient to produce an appreciable lengthening of the day in historical times, unless the conductivity lies within certain narrow limits. The absence of any marked effect cannot, therefore, be brought forward as an argument against the conductivity of space; second, the magnetic reactions of the same current, taken in conjunction with the secular cooling of masses of iron inside the earth, tend to produce a displacement which in kind is the same as that actually observed in the secular variation. But whether quantitatively the variation can be explained in this way is doubtful, and can only be decided by further calculations.

Lord Kelvin, Magnus MacLean and Alexander Galt presented a paper on "Preliminary Experiments to Find if Subtraction of Water from Air Electrifies It," which seemed to show that such a process results in positive electrification, while the addition of moisture had apparently the opposite effect of negative electrification.

Association of Edison Illuminating Companies of the United States.

The convention of the Association of Edison Illminating Companies was held at the Hotel Vendome, Boston, on the 14th, 15th and 16th of August. This association is composed of the officers of lighting companies using the Edison system, who meet every year to discuss matters of mutual interest and strengthen the common bond which unites them all. The meeting this year was most successful from every point of view and its memory will long linger in the minds of those who were fortunate enough to be present.

TUESDAY, AUGUST 14.

First Session.

The following companies were admitted as new members of the association: Toronto Incandescent Light Company, Toronto, Ont.; Cleveland Electric Illuminating Company of Cleveland, O.; Atlantic City Electric Light Company of Camden, N. J.; Edison Illuminating Company of Cincinnati, O.; Edison Electric Illuminating Company of Atlanta, Ga.; United States Electric Light Company of Washington, D. C.; Union Electric Light Company of Seattle, Wash.

The first business of the meeting was the reading of a report by Mr. A. E. Kennelly, chairman of the committee on "Lightning Protection, Crosses With High Tension Wires, and Grounding the Neutral Wire on the Three Wire System." He gave a summary of the experience of Edison stations up to date from these dangers, with suggestions as to the means of preventing them. The report was accepted, and the subject was considered of sufficient importance to continue the committee. The reading of the committee's report was followed by an exhaustive discussion, in which Prof. Marks, Mr. Gilbert, Mr. Beggs and Mr. Edgar participated.

Prof. Marks' paper on "A Board of Control for Central Station Management Composed of the Heads of the Different Departments Making up the Organization," was then heard. This matter Prof. Marks has investigated in very great detail, fully elaborating all the important elements which enter into the composition of this question of business. The discussion which followed indicated the interest evinced by the representatives of other illuminating companies present, and also developed the fact that many differences of opinion existed, as regards not only the details, but the general principal upon which this Board of Control should be based.

The next in order was Mr. Hale's paper on "Boiler Testing." This paper was the result of a series of tests made at the new station of the Edison Electric Illuminating Company of Boston, and put before the convention some facts which have never previously been published in America. This paper was discussed at considerable length by the technical men present, who took a strong interest in the facts presented.

Second Session.

After the formal opening of the session, Mr. Van Vleck proceeded to read his paper on the "New York Illuminating Company's Switchboard." This paper started with a description of the switchboard in its earliest and most primitive forms, and ended by giving in contrast the well worked out plans of the regulating gallery at present being installed in the Duane street station of the Edison Electric Illuminating Company of New York. This paper prompted many questions from interested persons, especially in connection with the Edgewise system of electrical instruments developed by the author of the paper.

Following Mr. Van Vleck, Mr. Page read a paper on "Incandescent Lamps," which was presented to the Northwestern Electric Association and published in The Electrical World of August 4.

Mr. Barstow, of the Edison Illuminating Company of Brooklyn, then read a paper on the "Low Tension Arc Lighting System," describing the system used by the Brooklyn company in lighting the central portion of the city of Brooklyn from the low tension mains of the Edison Company in a manner never before attempted, this being the first instance in America where street lighting has been done from the low tension mains of the regular Edison underground system. This being the case, it had to be developed in all its details, including lamp posts, automatic clocks and kindred devices. The paper called forth many questions from interested members present. Mr. Barstow presented in this paper some data which seemed to show conclusively to the members present that this form of lighting would be a valuable adjunct to their central station business.

Mr. Pierce's paper followed on the "Methods of Electrical Distribution Adopted by the Edison Illuminating Company of Boston." This paper was presented as an introduction to the visit which the members were to make to the station in question the following day, and simply called the attention of the delegates to the various points of interest which they might desire to look at during their visit.

WEDNESDAY, AUGUST 15.

First Session.

The second day's proceedings commenced with a "tally-ho" ride in the western suburbs of Boston, Chestnut Hill Reservoir, the Country Club, etc. Immediately upon the convening of the convention on Wednesday morning, the article on "Storage Batteries," by Mr. Bowker, of the New York Edison Company, to which all the members of the Association had looked forward with a great deal of interest, was read in Mr. Bowker's absence by Mr. Lieb, of the same company. Mr. Lieb presented, in conjunction with this paper, a paper of his own on the same matter, and nearly the whole session was taken up with an exhaustive description of the storage battery as applied to central stations. These papers developed much discussion, both for and against the practical value of the storage battery as an adjunct to central stations, and probably proved one of the most interesting and valuable discussions of the entire convention. A special committee was appointed by the president to consider and report upon this important subject.

Second Session.

The second session of the day was given up to matters pertaining to the relations with the General Electric Company, and included an address by Mr. C. A. Coffin, and an exhaustive paper by one of the General Electric Company's engineers, Mr. Emmet, on "The Relative Advantages of Alternating and Direct Current Apparatus for Central Station Work," which was discussed at great length and many interesting facts brought out in connection with the new "Monocyclic System" of the General Electric Company.

The committee on officers for the ensuing year brought in the following names in their report, which was unanimously adopted and nominees present declared duly elected:

President, C. L. Edgar, vice-president and general manager of the Edison Electric Illuminating Company, of Boston; vice-president, A. L. Smith, of Appleton, Wis.; secretary, W. S. Barstow, of Brooklyn, N. Y.; treasurer, J. W. Lieb, of New York. Executive Committee: John I. Beggs, chairman; C. P. Gilbert, Detroit, Mich.; E. R. Weeks, Kansas City, Mo.; W. D. Marks, Philadelphia, Pa.; G. R. Stetson, New Bedford, Mass.; C. L. Edgar, ex-officio, Boston.

At the urgent invitation of Mr. C. P. Gilbert, of the Detroit Edison Company, it was unanimously resolved that the next convention be held in that city on August 14, 1895. Votes of thanks were passed to the Boston Edison Illuminating Company, the New England Telegraph and Telephone Company, the Boston and Gloucester Steamboat Company, the West End Street Railway Company, and the Hotel Vendome, for courtesies extended, and the formal business of the convention concluded. The convention then adjourned.

THURSDAY, AUGUST 16.

On Thursday morning, following the adjournment, the party were conducted to the Albany street station of the West End Street Railway Company, where they had an opportunity of inspecting this magnificent plant. They afterwards visited the latest station of the Boston Edison Company on Atlantic avenue, where direct connected vertical engines and dynamos are employed. This is considered a model modern central station. A late addition is the storage battery auxiliary plant.

The plant generally and the elaborate switch-board arrangements were explained by the officers of the local company, and with especial reference to Mr. Pierce' paper. The visitors were then taken in charge by the representatives of the General Electric Company, who had arranged a most interesting exhibit at the Lynn works for their inspection. This visit was of unusual importance and interest as it was the first time that representatives of Edison operating companies had inspected, at least in their official and associated capacity, these extensive works.

On arriving at Lynn, lunch was served, after which Prof. Thomson, Mr. E. W. Rice, technical director; Lieut. S. Dana Greene, manager lighting department; W. C. Fish, manager Lynn factories; J. R. Lovejoy, manager supply department; I. F. Baker, mechanical department, and F. P. Cox, of the meter department, well known and zealous co-adjutors in the establishment and developement of the company, did the honors of the factory. Naturally, the construction and modes of testing of the various sizes (from 3 to 5000 amperes) and types of meters attracted much attention. A new meter of special efficiency for Edison circuits was shown, and also meters for arc-light circuits and for indicating the entire output of central stations, as well as portable and tropical meters.

Arc lamps of all kinds were on exhibition—long, short, plain, ornamental; lamps for series work and for alternating currents, as well as the Thomson '93 lamps for constant potential service.

The various processes and operations involved in the construction of dynamos, motors, meters and other apparatus were examined with much satisfaction. The extensive machine shops, winding rooms, testing rooms, (in large part operated by electric motors) the winding and insulation of armature coils, the tempering and setting of magnets for the meters, and the various labor-saving devices formed a most instructive and agreeable display.

Several large transformers for the Cataract Construction Company called for special notice. A 300kw. alternator of 125 cycles periodicity was in operation, smaller alternators and apparatus of lower frequency being also exhibited. Another exhibit in actual operation was a street railway track, equipped with two G. E. 800 motors and series parallel controllers, the whole of the wiring and connections being exposed to view.

Transformers of various kinds, lighting arresters, compensators, fuses, switches and samples of all sorts of supplies were also open to inspection.

An unexepected, but very agreeable addition to the pleasures of the afternoon was afforded in the shape of an exhibition by Professor Thomson of some of the phenomena of electricity under high pressure and high frequency. Professor Thomson in his usual charming and unaffected manner explained the peculiar action of currents of enormously high potential when used with exceedingly rapid alternations, many times that of the ordinary frequency. Under these conditions a person can have passed through his body without injury a quantity of current which, if a direcct current or at low frequency would almost certainly cause death. The apparatus used on this occasion raises by means of a transformer the usual alternating current of say 1,000 volts and of 15,000 alternations per minute, to a pressure of some 20,000 or 30,000 volts. This high potential then charges a condenser, and discharges over an air-gap across which an air-jet is blowing, producing high frequency currents. These currents are raised to a still higher pressure by a transformer (without iron) immersed in oil of high insulating properties, the final difference of potential between the terminals of the apparatus, as here shown, being estimated at about 1,000,000 volts.

Some interesting experiments were shown illustrating the high self-induction in a thick copper conductor subjected to currents of this nature. A thick wire of copper—apparently about No. 00 B & S—was connected directly across the terminals of the apparatus, in the form of a loop with only one turn. This was successively shunted by a thin piece of insulated wire further protected by card, by an incandescent lamp, by a fine piece of high resistance wire (which was heated to incandescence), and by the professor himself, (who, however, retained his normal placidity of demeanor); in all these cases the discharge followed what would ordinarily be considered the path of highest resistance.

That there was an appreciable current flowing was shown by the fact that Professor Thomson introduced himself in series with a 10 c.p. lamp, into the circuit, and it was evident that at least considerable current was passing. A discharge was passed along a thin wooden stick, which it was eventually allowed to consume, and another experiment with a water column (the sparks passing around instead of through the water) showed the fallacy of asuming that a water connection for a lightning ground must of necessity be satisfactory.

A number of other experiments were given showing the apparently erratic character of currents of this nature, in their various manifestations, simulating the nature of the lightning discharge.

The visitors expressed their appreciation of the interesting nature of this portion of the programme by frequent and hearty applause.

The party subsequently proceeded to the river works of the company, where they inspected the foundry connected with the factory, and saw the various processes connected with the preparation and casting of fields for generators, motors and other work of the same character. Thence coaches and drags conveyed the party for a drive from Lynn to Marblehead Neck, returning to Swampscott in time for dinner. On this portion of the exercises the presence of ladies graced the occasion, as was also the case at two or three theatre parties, this feature adding an additional charm to the proceedings.

The dinner at the Ocean House, Swampscott, was, as might be expected, of an excellent and artistic character. Mr. Coffin welcomed the guests in his graceful and hospitable manner, expressing his great pleasure in greeting the visitors and offering his assurance of harmonious and cordial relations in the future. Professor Thomson also made some pleasant remarks, referring in some degree to technical matters, and Lieut. S. Dana Greene congratuated the company and the representatives present on the agreeable relations of the various interests and the prospects for future business.

EXHIBITS.

The General Incandescent Arc Light Company of New York, showed a very fine exhibit of its latest "Bijou" and "Twin" Bergmann lamps, both in plain form and with artistic dead-black iron and polished brass ornamentation. The "Bijou" lamp is adapted for currents of small quantity, and is especially suited for interior illumination, and particularly for low-studded rooms. The "Twin" lamps are designed to enable street arc lighting to be provided for by means of the ordinary incandescent current, the two carbons being operated in series in one lamp, so that two pairs of carbons taking a current of four amperes each will give an illumination equivalent to one pair using eight amperes. For street lighting purposes it is evident that this system permits of a notable economy and convenience in wiring. The latest form of Bergmann short lamps has a chain-feed, the chain being wound upon a spring drum whose movements are controlled by a shunt-magnet. The carbon holders are adjustable to any size of carbon, and the mechanical parts are few and simple and characterized by the usual excellence in workmanship noticeable in "Bergmann" apparatus.

The Solar Arc Lamp Company, represented by Mr. H. W. Weller, had an interesting exhibit of different styles of arc lamps for constant potential circuits. This lamp has a rack feed with an escapement, its construction being very simple, a shunt-magnet controlling the release of the escapement mechanism. Simplicity and steadiness are prominent features claimed for this lamp.

Another interesting exhibit was a Weston ammeter of large capacity, for central station use. The instrument is of course much larger than the ordinary type, and the scale is disposed upon the edge instead of the face of the apparatus, the whole being mounted on a uitable stand. The instrument is made to read up to 7,000 amperes, and the indications can be distinguished at a distance of several feet.

Dynamo-Electric Machinery.—IV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

13. Dynamo-electric machines may be conveniently divided into other classes, according to a variety of circumstances; for example, they may be divided according to the number of magnetic poles in the field frame, into

(a.) Bi-polar machines, or machines having only two magnetic poles.

Bi-polar machines may be sub-divided, according to the number of separate magnetic circuits passing through exciting coils, into single-circuit bi-polar, double-circuit bi-polar machines, and so on. Generally, however, modern bi-polar machines are not constructed with more than two magnetic circuits. Figs. 1, 2, 3 represent bi-polar machines. Of these, Fig. 1 possesses a single magnetic circuit, and Fig. 2 a double magnetic circuit.

(b.) Multipolar machines, or machines having more than two magnetic poles.

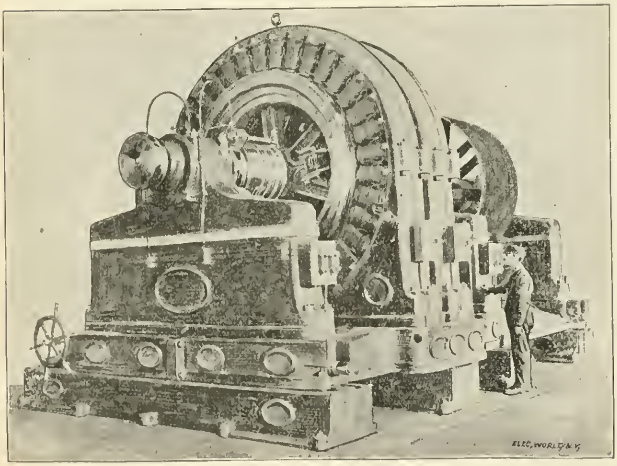


Fig. 9.—Alternating Current, 750 Kilowatt Diphase Multipolar Generator.

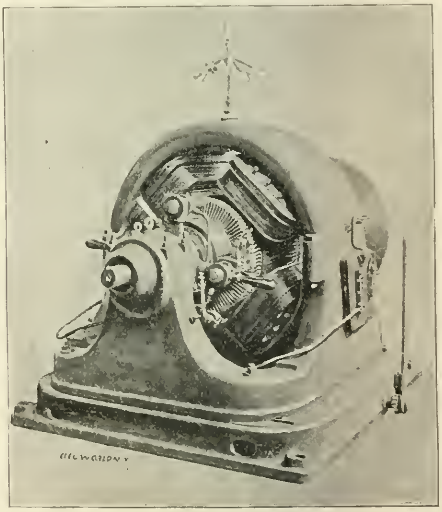


Fig. 10.—Continuous Current Self-Excited Compound-Wound Quadri-polar Generator.

Fig. 10 represents a multipolar, diphase alternator of many poles. This machine was employed at the World's Columbian Exhibition.

14. Multipolar machines may be divided into the following subclasses:

Tri-polar, or those having three poles.
Quadri-polar, or those having four poles.
Sexti-polar, or those having six poles.
Octo-polar, or those having eight poles.
Deci-polar, or those having ten poles.
Duodeci-polar, or those having twelve poles, etc.

Tri-polar machines are seldom constructed. Quadri-polar machines are common. Fig. 11 shows a quadri-polar machine. This machine has four brushes and is compound wound. It is designed to supply 500 to 600 volts pressure at its brushes, and is surmounted by a group of six pilot lights in series.

Fig. 7 also represents a quadri-polar generator.

Fig. 12 shows a form of continuous current, self-exciting, compound-wound, sexti-polar machine, arranged for direct connection

to the main shaft of an engine. The machine is provided, as shown, with six collecting brushes.

Fig. 12 shows an alternating-current, self-exciting, octo-polar generator for arc circuits. Although this machine is an alternator, i. e., supplies alternating currents, it, nevertheless, supplies its field-magnet coils in series with continuous currents from the commutator, C, at one end of its shaft. The magnet forms an essential part of a short-circuiting device whereby the machine is automatically

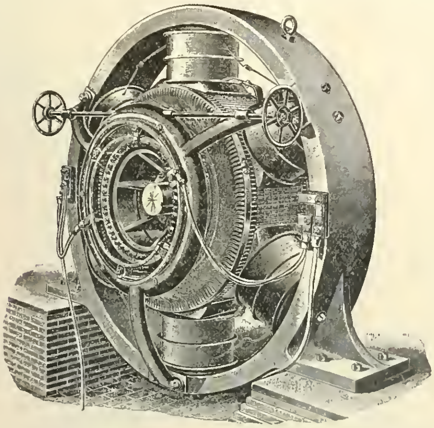


Fig. 11.—Continuous Current, Self-Excited Generator.

short-circuited, on the external circuit becoming accidentally broken, when the pressure generated by the machine may become so great as to endanger the insulation of the armature.

Fig. 13 shows a deci-polar alternator, separately excited, and compensating. This machine is belt-driven, and it drives in turn a small dynamo, D, employed for exciting the ten field magnets. The commutator, shown at c, is provided for the purpose of automatically increasing the pressure at the brushes of the machine with the load, so as to compensate for drop of pressure in the line or armature.

As we have already observed, bi-polar machines may be subdivided into classes according to the number of magnetic circuits

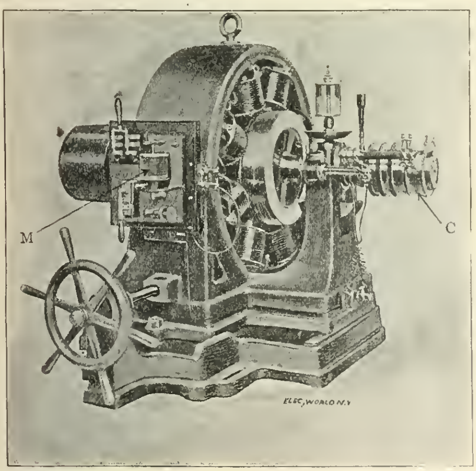


Fig. 12.—Alternating Current Self-Excited Octo-polar Generator.

passing through their exciting coils. In general, multipolar machines may be similarly classified. But, as usually constructed, there are as many independent magnetic circuits as there are poles. Thus, a quadri-polar generator has usually four magnetic circuits, a sexti-polar six, and so on. In some cases, however, a double system of field magnets is provided, one on each side of the armature; in this case, the number of magnetic circuits may be double the number of poles.

15. In designing a continuous-current generator, the number of poles in the field is to a certain degree a matter of choice. In almost all cases, directly coupled, continuous-current dynamos are multipolar, while belt-driven dynamos are commonly bi-polar. Directly-coupled, continuous-current dynamos are usually multipolar machines, owing to the fact that in order to conform with engine construction, they have to be made with a comparatively slow speed of rotation, and since the E. M. F. generated depends upon the rate of cutting magnetic flux, if the speed of the conductor is decreased, the total amount of flux must be correspondingly increased. This necessitates a greater cross-section of iron in the field magnets, in order to carry the flux, and this large amount of iron is most conveniently and effectively disposed in multiple magnetic circuits. To a certain extent the number of poles is arbitrary, but usually, in the United States, the greater the output of a direct-driven generator, the greater the number of poles.

In alternators, however, the case is different. Here, in order to conform with a given system of distribution, the frequency of alternation in the current is fixed, and since the speed of revolution of the armature is determined within certain limits, by mechanical considerations, or by the speed of the driving engine, the number

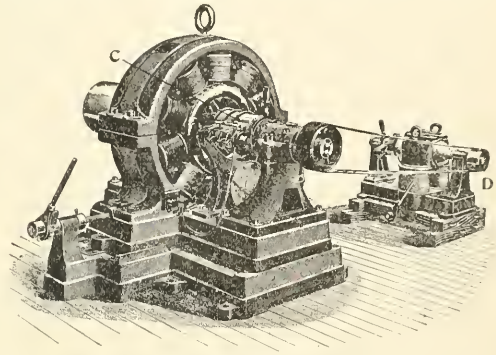


Fig. 13.—Alternating Current Separately Excited Deci-polar Compensating Generator.

of poles is not open to choice, but is fixed by the two preceding considerations. In any alternator, the number of alternations of E. M. F. induced per revolution in the coils of its revolving armature, is equal to the number of poles, consequently an alternator producing a frequency of 133′; that is a frequency of 133 complete periods or cycles per second delivers 266 alternations from each coil, and its armature must, therefore, pass 266 poles per second.

(To be Continued.)

Heroic Method of Preventing Fire Damp Disasters.

A Frenchman recently suggested preventing disasters due to the explosion of fire damp in coal mines by igniting the gases by electricity before the miners enter the shaft. If the gases are ignited continuously as fast as generated, and if the generation is not too rapid or too sudden, the method is prehaps not as unreasonable as might appear at first thought.

Niagara Falls Power Transmission.

The elaborate speculations, recently published in American journals, concerning the distance to which the Niagara Falls water-power can be transmitted economically, are claimed by the Lond. "Elec." to be a little premature; "there is a ludicrous resemblance to betting on the future jumping performances of an unhatched frog."

One of the Evil Effects of Competition.

"In spite of the fact that Buckingham possesses both electric and gas works, it is likely that in the coming winter the streets will be lighted by oil. This comes of having gas companies."—The London Electrical Review. The gas companies will probably say "this comes from having electric light companies."

Action of a Transformer with a Condenser in Parallel with the Secondary—II.

BY FREDERICK F. BEDELL AND ALBERT C. CREHORE.

EFFECTS OF A VARIATION IN THE CAPACITY OF THE CONDENSER WHEN THE ELECTROMOTIVE FORCE AT THE CONDENSER TERMINALS IS CONSTANT.

In Fig. 5 is reproduced Fig. 4, with lines added which show the variation in the quantities when the capacity of the condenser is changed. The same letters designate corresponding points in the different diagrams. As the capacity is varied, the condenser current changes its magnitude only. Its direction is always at right angles with OC, and its locus therefore upon the straight line labeled I_c. The line current, OD, does not change with the capacity, since the E. M. F. at the terminals of the line is supposed constant. Hence the transformer current, OT, has for its locus the line labeled I_t, parallel with I_c.

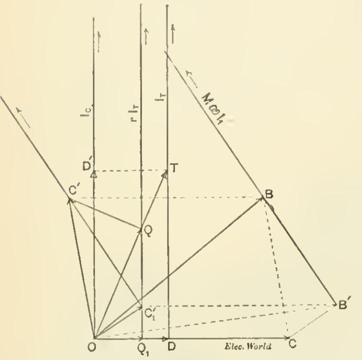


Fig. 5.—Constant Condenser Potential Diagram Illustrating Change of Capacity.

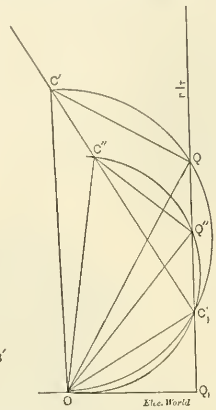


Fig. 6.

The E. M. F., OQ, for the transformer resistance is proportional to OT, and hence moves upon the line labeled rI_t. The angle $C'OQ$ is always equal to arc tan $\frac{L_2\,\omega}{r}$, and is therefore constant for all positions of the triangle $C'OQ$. The angle at Q is always a right angle. Hence $C'OQ$ is always similar to itself in any position. Under these circumstances, it follows that the locus of the point C' is the straight line $C'C_1'$; and the point C_1' is a point upon Q_1Q, such that tan Q_1OC_1' equals $\frac{L_2\,\omega}{r}$.

This may be proved as follows: Fig. 6 represents that portion of Fig. 5 under consideration. The angle Q_1OC_1' equals arc tan $\frac{L_2\,\omega}{r}$. Draw $C_1'C'$ at right angles to OC_1', from C_1'. It will appear that this line is the locus of the vertex C' of the triangle $C'OQ$ as it moves with its right angle upon QQ_1, always being similar to itself. Take any point, Q, and from it draw QC', perpendicular to OQ, until it meets $C_1'C'$ at C'. Likewise, take another point, Q'', and, in a similar manner, draw $Q''C''$. The triangles QOC' and $Q''OC''$ are now similar, for, describe a semicircle, $C'QC_1'O$, about OC' as diameter, and another, $C''Q''C_1'O$ about OC'' as diameter. Each of these arcs passes through the point C_1', because $OC_1'C'$ is a right angle. Now, the arcs $C'Q$ and $C''Q''$ measure equal angles at the centres of their respective circles, since each subtends the inscribed angle $C'C_1'Q$. Hence the inscribed angle $C'OQ$ is equal to the inscribed angle $C''OQ''$, as each is subtended in the respective circles by the arcs $C'Q$ and $C''Q''$. Hence the triangles $C'OQ$ and $C''OQ''$ are similar. But as these represent any two positions of the triangles, the proposition is proved.

Returning to the diagram (Fig. 5), it has been proved that OC' lies upon the line $C_1'C'$. This is that part of the impressed E. M. F. which goes to overcome the transformer impedance. OC is that part which overcomes the impedance of the divided circuit. The resultant of OC and OC' is OB, the transformer impressed E. M. F. Since OC is constant, OB varies along the line BB', parallel with $C_1'C'$, as the condenser capacity changes. When the capacity is zero, D' coincides with O, T' with D, Q with Q_1, C' with C_1', and B with B'.

This completes the diagram showing the effect of any change in the capacity, and, before altering the diagram to represent the case where the electromotive force, OB, is kept constant, we will draw the diagram showing the effect of a change in the resistance, R.

EFFECTS OF A VARIATION OF SECONDARY LOAD WHEN THE ELECTROMOTIVE FORCE OF THE CONDENSER IS CONSTANT.

We have reproduced in Fig. 7 the lines of Fig. 4, and added more to show the variation of the different quantities as the secondary resistance is changed. As the capacity is constant, OD' remains fixed, but OD, the line current, varies inversely as R, and consequently D moves upon the line OC. The resultant of OD and OD', viz., OT, therefore varies upon the line labeled I_t, which is parallel with OC. The E. M. F., OQ, to overcome the transformer resistance, being proportional to OT, lies upon the line rI_t. It may be proved, in a similar manner to the proof already given, that the locus of C' is upon the straight line $C_1'C'$, which makes an angle arc tan $\frac{L_2\,\omega}{r}$ with the line rI_t. The locus of $M\,\omega\,I_1$ or of OB, is consequently a line BB', parallel with $C'C_1'$, so that when the resistance is infinite, B coincides with B', Q with Q', T with D', and C' with C_1'.

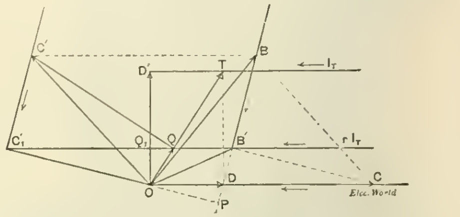


Fig. 7.—Constant Condenser Potential Diagram Illustrating Change of Line Resistance.

This completes the diagram, as far as a variation of the resistance alone affects it, from the standpoint of constant condenser potential.

Having obtained the diagrams for each case, viz., when the condenser capacity is varied, and when the secondary resistance is altered, from the consideration of constant potential at the condenser terminals, it is desirable to so alter these diagrams that the electromotive force induced in the transformer secondary will be constant, while the other quantities change. This occurs when the transformer primary is supplied with a constant current. The diagrams will then conform to the usual standard constant current form, which may easily be compared with others already obtained. They may also be changed so as to represent a constant primary impressed electromotive force.

In order to change the previous diagrams into those which are desired, the following general remarks in regard to the relation between directed or vecor quantities may prove of assistance, if they are not indeed essential to the method of solving the problem in hand. In the question before us, referring to Fig. 5, we have seen that, if OC represents the constant electromotive force at the condenser terminals, then OB, which represents the impressed electromotive force in the transformer, varies upon a straight line, BB', as the condenser capacity is changed.

The question now is, how would OC, the condenser electromotive force, vary, if we select some value of the secondary electromotive force, as OB, to be kept constant? We know that for any given angle of phase difference between OC and OB, as COB, the relative magnitudes, that is the ratio, of the lines, must always remain the same, independent of absolute magnitude. This enables us to determine the character of the locus of OC when OB is taken as constant. To make the proposition general, refer to Fig. 8. Here we have any line MN along which a variable vector OB' moves; and let OC represent some vector constant both in magnitude and in its direction with relation to OB'. Let OB be a certain position of the variable vector, which it is desired to maintain constant. To find the locus of the varying positions of OC, which, when variable, we call OC, so moving that the ratio of OC to OB is the same as that of OC to OB' for any constant angle of phase difference, we may construct the locus by points as follows. OB' is a particular value of the variable which makes the angle $B'\,OC_1$ with the constant. Resolve OB' to OB'' and OC_1 to OC_2 so that the angle

$B' OC_1 = B'' OC_2$. Then change the magnitudes of both OB'' and OC_2 proportionally, making OB'' take the value OB. Then OC_2 becomes CO_1 which gives the required point on the locus. The change from OC_2 to OC may be effected by drawing BC parallel with $B''C_2$. It will be found that the locus is a circle whose diameter OS makes the same angle with OB as OC_1 makes with the perpendicular OP upon MN.

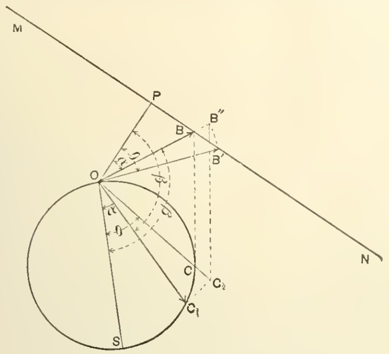


FIG. 8.—ILLUSTRATING GENERAL THEOREM.

These principles may be shown as follows: An equation of a straight line MN may be written,

$$OB' \cos \theta = OP = \text{a constant.}$$

Now OC_1 is a constant vector making an angle β with OP. Hence,

$$OC_1 \cos \beta = m\ OP, \qquad (1)$$

where $OC_1 \cos \beta$ is the resolved part of OC_1 along OP and is consequently some multiple, m, of OP. By the preceding equations

$$OB' \cos \theta = \frac{OC_1 \cos \beta}{m} = OP, \text{ a constant.}$$

In this equation OB' and θ are *variable* co-ordinates. But if it is desired to keep some value of OB' a constant, say OB, and to make OC_1 variable, say OC; we then have $OB \cos \theta = \frac{OC \cos \beta,}{m}$ or, solving for OC, $OC = \frac{m\ OB \cos \theta}{\cos \beta}$. Here $\frac{m\ OB}{\cos \beta}$ is a constant, equal to OS we will say. Then,

$$OC = OS \cos \theta.$$

This is the equation of a circle, and shows that OC is a variable in a circle with diameter OS. The position of the diameter OS is determined by the relation above

$$m\ OB = OS \cos \beta. \qquad (2)$$

Dividing (1) by (2);

$$\frac{OC_1}{OS} = \frac{OP}{OB} = \cos a.$$

Thus OS makes the same angle, a, with OC_1, as OB_1 makes with the perpendicular OP; this defines both the magnitude and direction of OS, the diameter of the circle. This general theorem may be stated as follows:

If a variable vector, OB', has its origin at a point O, and terminus upon a straight line, MN, while OC_1 represents some constant vector; then another variable vector, moving upon a circle OCS (whose diameter, OS, makes the same angle, β, with a constant vector, OB, as the constant, OC_1, made with the perpendicular, OP, upon the straight line (MN) preserves the samerelative magnitude, or ratio, to its constant, OB, as the first variable, OB', bears to its constant, OC, for the same angle of phase difference.

(To be Continued.)

An Incident of the Early Days of Telegraphy.

Yesterday was the fiftieth anniversary of the birthday of Prince Alfred, Duke of Edinburgh, and reigning Duke of Saxe-Coburg. During the early morning of August 6, 1844, the electric wire was first utilized on behalf of the Queen, to transmit from Windsor Castle to the Metropolis a Royal summons to the Cabinet Ministers then in office commanding them to repair to the Castle forthwith in view of the expected birth of a Prince or Princess. As a matter of fact, the despatch was forwarded by messenger to Slough Station, whence it passed over the wires of the Great Western Railway to Paddington Terminus. There arrangements had been made with Mr. Thomas Home, the sole licensee of the Cooke and Wheatstone telegraphic apparatus, who is still living, that on receipt of a message by wire, couched in certain prescribed terms, he should forthwith send to the respective addresses of the several Cabinet Ministers certain letters that had previously been intrusted to his keeping.

At the time when British Royalty thus accorded its patronage to telegraphy for the first time and in connection with a highly "interesting event," the instruments in use for the transmission of messages were Mr. Cooke's "double and single needle" telegraphs, and Professor Wheatstone's "electro magnetic printing," and "A. B. C." telegraphs. From 1842 to 1846, as we are informed, the charge levied was one shilling per telegram, irrespective of length, the messenger's fee being, of course, an "extra," bearing proportion to the distance to be covered before delivery. Messages were as correctly transmitted then as now, but by no means so rapidly, Practical telegraphy, in fact, was in its infancy when the Queen's second son made his debut upon the mundane stage. Its mechanical appliances were steadily being improved by the light of successive and assiduous experiments, but its popularity was not yet established upon a solid basis of public belief in its actual and potential capacities. Many people wondered at it, though few understood it. As for the utterly incredulous, their name was legion fifty years ago. The instruments at Paddington were "on view" for a shilling fee, which was daily paid by numbers of curious folk for the privilege of seeing the telegraph at work, and listening to a more or less lucid explanation of its marvellous powers. The early promoters of telegraphic enterprise transmitted hundreds of messages free of charge in order to convince the unbelieving that it was actually possible to annihilate time and space in communicating between one and another part of Great Britain. Even the ingenious contrivers of the instruments then in use had hardly grasped the full significance of the surprising force they were busily engaged in disciplining and regulating, or had dreamed of the extraordinary developments which it would undergo in the course of the Victorian era. In those days of the two-penny post, when a railroad was still something of a novelty, and "fast" steam-packets took three weeks to cross the Atlantic, who could have reasonably looked forward to a period, only distant by the length of a generation, when—not only in huge London, but in every considerable town of the United Kingdom—the six-penny telegram would be as familiar an object to all classes of the population as the daily newspaper, the lamp-post, or the omnibus?—London Daily Telegraph, August 7, 1894.

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—I do not concur in the statement made by the "London Electrician," that "the elaborate attempts which are being made by some of the American builders to give this property to their machines is utterly useless and a complete waste of time and energy."

In successful operation for the transmission and transformation of energy, the E. M. Fs. of the receiving or transforming machinery are always carefully balanced against the impressed or generator pressures. In some cases these E. M. Fs. are produced as exact duplicates of the impressed E. M. Fs. in shape and form, as is the case in the transformer, when the form of the E. M. F. curves will make practically no difference.

It has been found that the synchronous motor works best when it produces a motor E. M. F. that has the same form as the generator that supplies it with power. All induction motors work best when the motor E. M. F. and the impressed E. M. F. in the secondary have the same form. Rotary transformers must produce the same form of alternating E. M. Fs. at the rings that are produced by the generator. In the synchronous motor the counter E. M. F. is developed in a way that is largely independent of the form of the impressed E. M. Fs., and this is also the case with the rotary transformer. In these cases it is true that if the E. M. Fs. are not of the same form, currents will be established that will bring about a balance through induction, reactance and heating, resulting only in useless internal waste of energy that would not occur in the synchronous motor or rotary transformer which produced the same form of E. M. F. curves. Again, in the induction motor, a certain primary and secondary winding will, as Dr. Duncan points out, produce counter and impressed E. M. Fs. that have the same form in the motor's sec-

ondary with but one form of generator curve. If the generator E. M. F. curve varies on either side of this particular form, the impressed and counter E. M. Fs. of the secondary will differ in form, and, therefore, greatly in value from instant to instant. The result of this is much the same as for the synchronous motor.

One company of American builders has used the condenser practically for supplying the reactance currents to the primaries of their induction motors. A condenser can only do this work properly when the generator E. M. F. has the sine form.

A prominent American engineer declares that in long distance transmission of power the reactance currents which lessen the power factor and produce bad line and generator regulation can be kept out of the line and generator by the use of synchronous motors. Again for this same purpose the above company advocates the use of condensers. With the former method the synchronous motor and line pressures must possess the same form; with the latter the line pressure must have the sine form. Now it seems to me that all this indicates that there should be a reasonable approach to a standard form of E. M. F. curve on the part of makers of standard apparatus.

The form of curve for synchronous motors and rotary transformers can make but little difference so long as it coincides with that of the generator. The sine form for a generator is more easily approached as a motor E. M. F. in the secondary of an induction motor than the flat or thin-topped form. The condenser is at a great disadvantage except with the sine forms of E. M. F. For electric lighting only, from transformers, one form of generator E. M. F. can have but little advantage over another. Special apparatus not involving the use of condensers can be made to run equally well with almost any practically obtainable form of curve. Standard machinery of one make that is to be used for other purpcses in addition to electric lighting will operate with machinery of another make only when strict attention has been given to the use of a standard form of E. M. F. Is there any form for a standard that presents more advantages and introduces fewer constructional difficulties or expenses than the sine form?

Ithaca, N. Y. HARRIS J. RYAN.

To the Editor of The Electrical World:

Sir:—In the mathematical treatment of alternating current phenomena the assumption is usually made that the wave is of sine shape, and this assumption is frequently justified by reference to the experimental tests of some pre-historic alternator, which just happened to give very nearly a sine wave, being in this regard very different from our modern ironclad alternators, which do not give anything like a sine wave.

Only very recently this theoretical objection has been overcome by defining the sine wave used in the calculation as the "equivalent sine wave," that is, a sine wave giving the same effective value and the same power as the true wave of the alternator, and therefore replacing it in practically all cases.

An enormous amount of theoretical discussion has been carried on to prove the superiority of the sine wave for motor work, for the efficiency of transformers, etc., and, I am sorry to say, mostly by theoretical men, who did not have any great chance to prove or disprove their theoretical conclusions by practical experience.

A number of claims of superiority made for the sine wave could, however, be easily refuted already by theoretical considerations. Take, for instance, the case of the efficiency of transformers. The hysteretic loss per cycle in the transformer exclusively depends upon the limiting values of magnetism, and will remain the same as long as these are the same. If the wave of E. M. F. is a sine wave, the magnetism will follow a sine wave also. If the wave of E. M. F. differs from the sine shape, we can consider it as a fundamental sine wave with higher harmonics superimposed thereon, and then the wave of magnetism will also be a distorted wave, consisting of a fundamental sine wave superimposed by sine waves of triple, quintuple, etc., frequency. It is obvious now that if the triple harmonic wave of magnetism is superimposed upon the fundamental wave in such a way as not to increase its maximum value, the core loss will not be increased, but the amount of energy transformed is increased by the energy of the triple harmonic, for, as known, the energy of an alternate current wave is equal to the sum of the energies of the individual harmonics, since:

$$\int_0^{2\pi} \left\{ \Sigma \ d_n sin(n\phi - \bar{\omega}_n) \right\}^2 d\phi = \tfrac{1}{2} \Sigma n d_n^2$$

In this case, the wave of magnetism will be flat-topped, and thus the wave of E. M. F. peaked, hence of a shape like that of the modern ironclad alternator. That means the sine wave of E. M. F. is not the most efficient for transformation, but the peaked form of wave as given by the modern ironclad alternators gives in transformation a lesser core loss, by from 9 to 10 per cent. Just here I have no more recent tests at hand and so am giving the experimental results of some tests carried out at the time when the introduction of the ironclad design of alternators was ventilated, and for this purpose careful tests made to find whether there is any difference in the action of transformers, between these machines and the old smooth core machines.

HYSTERETIC LOSS IN WATTS (August, 1891).

Transformer No.	Sine Wave.	Ironclad.	Difference.
35992	42.3	38.6	9.8%
36067	41.1	37.8	8.95%
36668	36.8	33.9	8.7%
35799	36.6	33.7	8.7%

Average difference in favor of the distorted wave of the ironclad: 9.03 per cent.

Coming now to the question of the influence of the wave shape upon the action of motors, I have always had some suspicion that the wave shape has been abused as a scapegoat for explaining the inefficiency of a motor due to improper design.

With the extensive introduction of induction motors in this country, it became necessary to see whether there is any difference in the action of a motor when operated by sine waves and by the waves of ironclad alternators. Tests, however, carried out by running one and the same three-phase induction motor—a properly designed motor, indeed—first from an alternator giving a sine wave, then from an ironclad alternator giving a sharp pointed wave, and lastly with a flat-topped wave given by reversing the current of a continuous current dynamo by a number of two-part commutators, showed no difference in the action of the motor with regard to output, efficiency, starting torque, etc., except that in a few cases there seemed to be a slight advantage in efficiency in favor of the distorted wave of the ironclad alternator, probably due to the lesser hysteretic loss caused by such a wave. This difference, however, was too small to be definitely proved. Since that time induction motors and synchronous motors are designed and built without further reference to the wave shape, and some thousands of kilowatts of motors in successful operation proved the correctness of this statement.

The question of resonance with higher harmonics, that is of the dangerous rise of potential, which may occur in long distance transmission by the combined action of capacity and self-induction, can easily be disposed of by the fact that a transmission line which is liable to give dangerous rise of voltage by resonance with the triple or quintuple harmonic is not fit for use with the fundamental wave either.

These considerations, which, as before said, I found fully proved by practical experience, have completely convinced me that the superiority claimed for the sine wave is a mere superstition without actual foundation, and that in ordinary distribution work the sine wave is rather at a disadvantage in transformers, so that I have given up any endeavor to build alternators with sine waves.

Thus I can only fully indorse the view taken by the "London Electrician" in its criticism of sine wave alternators, so far as the criticism is general.

To the particular machine, however, which started the discussion, this criticism does not apply, but in this machine considerations entirely outside of the question of transformer efficiency or motor work have induced me to choose a design giving a practically perfect sine wave; conditions, however, entirely specific to the central station, for which this machine is intended, and, therefore, of no further interest for the present discussion, except in so far as they prove that even with an ironclad construction of alternator—which is indispensable in modern times—practically perfect sine waves can be produced. CHAS. P. STEINMETZ.

Schenectady, N. Y.

The results of some tests just made of the core loss of a 200 kw. transformer very plainly bear out my statement. With the generator giving very closely a sine wave, the observed core loss was 3,300 watts, while with the wave of an iron clad alternator, at the same voltage and same frequency, the core loss was found to be only 2,860 watts, giving an advantage of over 13 per cent. in favor of the distorted wave of the ironclad. I may add that in this case the distortion of the wave was larger than usual, the ironclad being speeded down to the low frequency of 25 cycles. C. P. S.

Symbols for Physical Quantities and Abbreviations for Units.

Recommended by the Committee on Notation of the Chamber of Delegates of the International Electrical Congress of 1893.

With the names added in italics of the practical magnetic units provisionally adopted by the American Institute of Electrical Engineers.

Corrected by M. Hospitalier.

PHYSICAL QUANTITIES.	SYMBOLS.	DEFINING EQUATIONS.	DIMENSIONS OF THE PHYSICAL QUANTITIES.	NAMES OF THE C. G. S. UNITS.	ABBREVIATIONS OF THE NAMES OF THE C. G. S. UNITS.	PRACTICAL UNITS.	ABBREVIATIONS OF THE PRACTICAL UNITS.
Fundamental.							
LENGTH	L, l	....	L	Centimetre.	cm	Metre.	m
MASS	M	....	M	Mass of one gramme.	g	Mass of a kilogramme.	kg
TIME†	T, t	....	T	Second.	s	Minute ; hour.	m ; h
Geometric.							
SURFACE	S, s	$S = L.L$	L^2	Square centimetre.	cm^2	Square metre.	m^2
VOLUME	V	$V = L.L.L$	L^3	Cubic centimetre.	cm^3	Cubic metre.	m^3
ANGLE	α, β	$\alpha = \frac{\text{arc}}{\text{radius}}$	A number.	Radian.	....	Degree ; minute ; second ; grade.	
Mechanical.							
VELOCITY	v	$v = \frac{L}{T}$	LT^{-1}	Centimetre per second.	cm : s	Metre per second.	m : s
ANGULAR VELOCITY	ω	$\omega = \frac{v}{L}$	T^{-1}	Radian per second.	....	Revolutions (turns) per minute.	t : m
ACCELERATION	a	$a = \frac{v}{T}$	LT^{-2}	Centimetre per second per second.	cm : s^2	Metre per second per second.	m : s^2
FORCE	F, f	$F = Ma$	LMT^{-2}	Dyne.	dyne	Gramme ; kilogramme.	g; kg
WORK	W	$W = FL$	L^2MT^{-2}	Erg.	erg	Kilogrammetre.	kgm
POWER	P	$P = \frac{W}{T}$	L^2MT^{-3}	Erg per second.	erg : s	Kilogrammetre per second.	kgm : s
PRESSURE	p	$p = \frac{F}{S}$	$L^{-1}MT^{-2}$	Dyne per square centimetre.	dyne : cm^2	Kilogram per square centimetre.	kg : cm^2
MOMENT OF INERTIA	K	$K = ML^2$	L^2M	Gramme-mass-centimetre-squared.	g-cm^2		
Magnetic.							
STRENGTH OF POLE	m	$F = \frac{m^2}{L^2}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$				
MAGNETIC MOMENT	$\mathcal{M}$	$\mathcal{M} = ml$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}$				
INTENSITY OF MAGNETIZATION	$\mathcal{I}$	$\mathcal{I} = \frac{\mathcal{M}}{V}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
FIELD INTENSITY	$\mathcal{H}$	$\mathcal{H} = \frac{F}{m}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	....	*Gauss.*	
FLUX OF (MAGNETIC) FORCE	Φ	$\Phi = \mathcal{H}S$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$	*Weber.*	....	*Weber.*	
MAGNETIC INDUCTION	$\mathcal{B}$	$\mathcal{B} = \mu\mathcal{H}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	....	*Gauss.*	
MAGNETIZING FORCE‡	$\mathcal{H}$	$\mathcal{H} = \frac{4\pi NI}{L}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	....	*Gauss.*	
MAGNETOMOTIVE FORCE	$\mathcal{F}$	$\mathcal{F} = 4\pi NI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gilbert.*	....	*Gilbert*; 1 *Gilbert* = 0.7958 ampère-turns (a–t).	
RELUCTANCE (MAGNETIC RESISTANCE)	$\mathcal{R}$	$\mathcal{R} = \nu\frac{L}{S}$	L^{-1}	*Oersted.*	....	*Oersted.*	
(MAGNETIC) PERMEABILITY	μ	$\mu = \frac{\mathcal{B}}{\mathcal{H}}$	A number.				
(MAGNETIC) SUSCEPTIBILITY	κ	$\kappa = \frac{\mathcal{I}}{\mathcal{H}}$	A number.				
RELUCTIVITY (SPECIFIC MAGNETIC RESISTANCE)	ν	$\nu = \frac{1}{\mu}$	A number.				
Electromagnetic.							
RESISTANCE	R, r	$R = \frac{E}{I}$	LT^{-1}	....	....	Ohm.	ohm
ELECTROMOTIVE FORCE	E, e	$E = RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	....	....	Volt.	v
DIFFERENCE OF POTENTIAL	U, u	$U = RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	....	....	Volt.	v
INTENSITY OF CURRENT	I, i	$I = \frac{E}{R}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	....	....	Ampère.	a
QUANTITY OF ELECTRICITY	Q, q	$Q = IT$	$L^{\frac{1}{2}}M^{\frac{1}{2}}$	....	....	Coulomb ; ampère-hour.	c ; a-h
CAPACITY	C, c	$C = \frac{Q}{E}$	$L^{-1}T^2$	....	....	Farad.	F
ELECTRIC ENERGY	W	$W = EIT$	L^2MT^{-2}	....	....	Joule ; watt-hour.	J ; w-h
ELECTRIC POWER	P	$P = EI$	L^2MT^{-3}	....	....	Watt ; kilowatt.	w
RESISTIVITY (SPECIFIC RESISTANCE)	ρ	$\rho = \frac{RS}{L}$	L^2T^{-1}	....	....	Ohm-centimetre.	ohm-cm
CONDUCTANCE	G, g	$G = \frac{1}{R}$	$L^{-1}T$	....	....	Mho.	mho
CONDUCTIVITY (SPECIFIC CONDUCTANCE)	γ	$\gamma = \frac{1}{\rho}$	$L^{-2}T$				
COEFFICIENT OF INDUCTION (INDUCTANCE)	L, l	$L = \frac{\Phi}{I}$	L	....	....	Henry.	H

† The International Bureau of Weights and Measures has established an important distinction in the notation of time, according as it refers to the *epoch* (date of time or day) or the *duration* of a phenomenon. In the former case the reference letters are used as indices, and in the latter they are on the same line with the numbers; for instance, an experiment began at $2^h\ 15^m\ 46^s$, lasted 2h. 15m. 46s., and ended at $4^h\ 31^m\ 32^s$. This method is to be recommended.

‡ N is the number of windings, and L the length of the solenoid generating the magnetizing force.

NOTE.—The symbols for magnetic units are known to printers as *French script*, and may be so designated on MSS. The style here used, recommended by M. Hospitalier, is that of the foundry of Damon & Peets, 44 Beekman Street, New York.

DIGEST of Current Technical Electrical Literature

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING

ELECTRO-PHYSICS.

Vacuum Tube Experiments.—Sir David Salomons, in the London "Elec.," July 27, describes as a remarkable result the following experiment: A tube was fitted with two Hertz grids, placed midway in its length and crossed, under which conditions the current should not traverse the tube end to end; the result of a test was that under no conditions could the tube be made to show the faintest sign of light. In the issue of August 3, Mr. Pyke suggests that perhaps the connections for continuity were not traced out, and that it is therefore not right to assume that no light was produced by the passage of a current through a vacuum; he asks what proof existed that there was actually a current flowing.

Electrostatic Hysteresis.—Some further experiments by Mr. Arno are mentioned briefly in the Lond. "Elec.," August 3; the energy, dissipated by a dielectric suspended in a rotating electrostatic field, is equal to a constant multiplied by the electrostatic induction, raised to a power equal to 1.6 for low induction and 1.9 for high induction.

Rotation in Vacuum.—An experiment by Mr. Arno, in which a small wheel with metallic vanes is made to rotate by electrostatic fields, is described briefly in "L'Elec.," August 4.

Mechanical Effect of Electric Waves.—The Lond. "Elec.," July 27, abstracts briefly a paper by Mr. Lebedew from the "Wied. Ann.," No. 8, describing experiments to show the mechanical effects of electric waves.

Diselectrification of Bodies by Light.—In the Lond. "Elec.," July 27, Dr. Lodge gives an abstract, including illustrations, of a number of papers by Messrs. Elster & Geitel, published in the "Wied. Ann."

Analogy Between Electro Magnets and Induction in Looped Circuits.—In an article of some length in the "Elek. Zeit.," July 26, Mr. Christiani points out that there is a useful analogy between the induction of double circuits and electro magnets.

Determining the Form of Periodic Curves.—A further description of the electro-chemical method of Mr. Janet is given in "L'Ind. Elec.," July 25, and "L'Elec.," July 28 and August 4.

Electricity of Drops.—A paper by Prof. J. J. Thomson, in the "Phil. Mag." for April, is abstracted in the Lond. "Elec. Rev.," August 3.

Entropy.—An article giving some analogies is contained in the Lond. "Elec.," August 3.

MAGNETISM.

Effect of Magnetisation on Volume.—A Royal society paper by Mr. Bidwell on the effect of magnetisation on the dimensions and volume of iron rings, is reprinted, with the illustrations, in the Lond. "Elec. Rev.," August 3; results are given in tables and curves.

Magnetic Properties of Alloys.—Some results from a recent paper of Mr. Osmond, read before the French Academy of Sciences, are published in the Lond. "Elec. Rev.," July 27, the alloys tested containing various percentages of iron, with carbon, silicon and nickel, chiefly of the latter.

Hollow and Cylindrical Iron Cores.—The article by Mr. Du Bois, mentioned in the Digest, June 2, is abstracted briefly in the Lond. "Elec.," August 3.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Units and Quantities.—In "L'Ind. Elec.," July 25, Mr. Hospitalier publishes a summary of the systems suggested by Prof. Blondel and published in the Digest August 11, adding the suggestion that the last quantity in the table, called "quantity of light," be called by the name "lighting" (eclairage), this being the quantity in terms of which commercial lighting can be measured. He does not approve of the symbols suggested by Blondel, as some of them are the same as those used for other physical quantities; he recommends the discussion and adoption of such a system; he intends to adopt it in that journal. This system, he states, is a good development of the general ideas which he (Hospitalier) proposed in 1889.

Transportable Galvanometer.—A new form made by the firm of Hartmann & Braun, is illustrated in the "Elek. Zeit.," July 26; the telescope and scale are secured at the end by an arm, which is pivoted on the galvanometer itself; it is astatic and the needle has a long suspension.

Capillary Electrometer.—A Physical Society paper by Mr. Bouty, on the capacity of such instruments, is abstracted in "L'Ind. Elec.," July 25.

TRANSFORMERS.

Current Rushes in Transformers.—Mr. Hay's article (see Digest, August 4), is continued in the Lond. "Elec.," July 27; he discusses the curves obtained experimentally; in regard to the connection between the current rush and the phase of the current at the instant of switching off, he comes to the following conclusions: "(1.) If the switch is opened when the current is diminishing numerically, then the exact point on the current-wave at which the circuit is broken is immaterial, since the iron always returns to the same state. (2.) If the switch is opened when the current is increasing numerically, then a very slight difference in the instant of switching off may produce a considerable variation in the 'rush.' (3.) If the switch is closed at the instant when the e. m. f. has a small value, there will always be an abnormal current-rush, quite independently of the magnetic state of the iron." In the issue of August 3 he discusses the effect on the rush by varying the normal maximum of magnetic induction to which the iron is worked, illustrating it with several diagrams.

Transformer System.—In a communication to the Lond. "Elec. Rev.," July 27, Mr. Alfred Thompson discusses the Whitcher system and gives some results obtained with the Lowrie system. The Lowrie "interposed automatic system" of electrical distribution is described at some length, with illustrations, in the Lond. "Elec. Eng.," July 27.

ARC AND INCANDESCENT LIGHTS.

Economic Age of Incandescent Lamps.—In an article by Mr. Gasnier, in "L'Ind. Elec.," July 25, he applies to the results recently published by him (see Digest, June 9) the method suggested by Mr. O'Keenan for determining the most economical age at which incandescent lamps should be run; (the system is explained in an article in The Electrical World, December 24, 1892, page 404, and March 18, 1893, page 204). He assumes 20 cents for the cost of a kilowatt-hour and 30 cents for the price of a lamp. Six sets of curves are given, three for 10 c. p. lamps of 2.46, 2.84 and 3.4 watts per candle, respectively, and three for 16 c. p. lamps of 2.23, 2.51 and 3.2 watts per candle, respectively. He states that it would require an experienced eye to tell from simple inspection a difference of as much as 20 per cent. in the candle-power of lamps, and he therefore considers that lamps may be run up to a loss of 25 per cent. in candle-power. In the high efficiency lamps the best life as obtained from the O'Keenan curves is greater than that at which they lose 25 per cent., showing that, notwithstanding this loss in candle-power, it is still economical to use the lamp; with lamps having an efficiency of 2.84 and 2.51 watts per candle, the life obtained in these two ways is about the same, while for low efficiency lamps the life obtained from the allowable fall of candle-power is considerably greater than that obtained from the O'Keenan curves, and it will therefore be of advantage in this case to use the lamps longer than the point obtained from these curves. To show the advantage of forcing lamps he finds that the minimum price of a candle-hour for a 3.2 watt lamp is about 15 per cent. greater than that of a 2.2 watt lamp. He concludes that when lamps are forced below 2.6 watts per candle, it will be of advantage to the user to keep the lamps until they lose 25 per cent. of their candle-power, lamps of 16 c. p. originally being then still economical as 10 c. p. lamps; three watt lamps and over can also be used economically beyond the limit in the O'Keenan curves. It is not possible to fix once for all the most economical age for any make of lamps, there being such a variation among the lamps; the only guide is the variation in the candle-power; his rule, therefore, is to continue to use the lamps a little beyond the point corresponding to the admissible fall in candle-power.

Incandescent Lamps.—Some of the figures from Mr. Larnaude's article mentioned in the Digest July 28 and August 11, are given in the Lond. "Elec. Eng.," July 27.

Arc Lamps.—The serial of Mr. Kennedy is continued in the Lond. "Elec. Rev.," August 3. He discusses electromagnetic devices.

ELECTRIC RAILWAYS.

Locomotive vs. Motor Cars.—According to the English journals of July 27, the City & South London Underground Railway is about to make experiments with a view of substituting motors on the cars themselves in place of the present separate locomotive, thereby also enabling an additional car to be used in every train; as the running expenses have now become stationary at 12.4 cents per train mile (we believe a train comprises one locomotive and three short cars), it is thought that this change offers the best means for increasing the income.

Kiew Railway.—A description of this railway, including a number of illustrations, is given in "L'Elec.," July 28 and August 4; a number of the devices differ from those used in this country.

Rapid Transit in Cities—An editorial in the Lond. "Elec. Rev.," July 27, claims that the trolley system cannot be introduced in cities with crooked, narrow streets, and that the only suitable methods are

underground or elevated railways, using electrical traction; it claims that no system in which rails are not used can ever fulfill the necessary conditions, one of the reasons being that nothing but an iron way can stand the weight of vehicles carrying their own motive power.

Railway Circuits.—In "L'Elec.," July 21, Mr. Dieudonne summarizes the various methods of bonding rails, but giving apparently nothing new to Americans.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Cost of Electrical Energy.—The Lond. "Elec.," July 27 and August 3, publishes in full the communicated remarks on Mr. Crompton's recent paper on this subject and the author's written reply; the remarks of Mr. Sharp include a design for a flywheel, equivalent, under certain circumstances, to an engine of 400 h. p. for use in connection wth railway power stations. The subject is also discussed editorially. The device of Mr. Sharp is discussed unfavorably in an editorial, on the ground that no known material will stand the strain; in a communication in the issue of August 3, Mr. Sharp makes what appears to be a satisfactory reply.

Large Three-phase Plant.—According to the Lond. "Elec. Eng.," July 27, what is said to be the largest station which has been designed for this system, has been carried out by the firm of Siemens & Halske, of Chemnitz; there are three engines and dynamos, each of about 200 h. p., the voltage being about 2,000; there has been a large demand for motive power, amounting to about one-third of the capacity; the working is satisfactory, especially in case of parallel running.

Polyphase Systems.—The leading editorial in the Lond. "Elec. Rev.," August 3, advocates polyphase systems, but contains nothing new.

Alternating Current Distribution.—An editorial in the Lond. "Elec. Rev.," July 27, chiefly of local interest, discusses the arrangement of the leads, stating that to put both in the same pipe or to run them concentrically, has proved to be very satisfactory, notwithstanding objections to the contrary by advocates of the continuous current system.

Manchester.—A description of the new electric lighting station by Dr. John Hopkinson is given in the Lond. "Elec. Eng.," August 3.

Budapest.—A description, with three full-page illustrations of the connections, is published in "L'Ind. Elec." July 25.

Gas Engine.—According to "L'Ind. Elec.," July 25, the Charon engine recently tested, showed a consumption of 37.9 cu. ft. of gas per horse-power hour with an "organic" efficiency of 52.6 per cent. at one-third of its output; at one-half output the values were 26.4 and 63.1 per cent., and at full charge 17.1 and 89.2 per cent.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction Telegraphy.—A Royal Society paper by Mr. Stevenson, is published apparently in full in the Lond "Elec. Eng'," July 27, and in abstract in the Lond "Elec.," August 3; he describes a recent trial made on a large scale with his system in which communication from a lighthouse on an island to the mainland was established; two coils, consisting each of nine turns, 200 yards in diameter, of No. 8 iron wire, were used, one on the mainland and one on the island, the distance between the centres being 850 yards, the current being one ampere; 100 dry cells gave good results, the reading in the secondary being made by two telephones; with fifteen cells the messages could still be sent. He describes some experiments made to test the relative merits of the parallel wire and the coil systems, and concludes "that it has been admitted to be shown that the coil system is not only theoretically but practically the best."

Disturbances in Telephones Due to Railway Circuits.—An article by Messrs. Meyer & Muetzel is contained in the "Elek. Zeit.," July 26; it is supplementary to their article abstracted in the Digest June 9, and relates to subsequent experiments made with telephones of lower resistance, such as those without induction coils for short distances; they found that the noises produced by the railway currents were then very much greater and could be heard when no sounds could be heard with the high resistance instruments; they therefore recommend the use of high resistance instruments in such cases; they conclude that induction is the chief cause of the trouble, that due to the earth currents being of much less importance.

Submarine Telegraphy to the Far East.—The Lond. "Elec.," Ju y 27, publishes a supplement containing the speeches made at the recent silver jubilee (twenty-fifth anniversary) of submarine telegraphy to the far east; it contains an article on the summary of the progress of submarine telegraphy; the subject is discussed editorially. The Lond. "Elec. Rev.," July 27, also contains an article on this subject.

Two New Atlantic Cables.—An article on this subject is contained in the Lond. "Elec. Rev.," July 27. It is stated that including the cable at present being laid by the Anglo-American Company, the number of cables crossing the northern Atlantic is fifteen, of which three have been definitely abandoned and eleven are in a more or less perfect state of repair.

New Caledodian Cable.—Mr. Reynier's article, mentioned in the Digest, July 28, is abstracted in the Lond. "Elec. Rev.," July 27,.

ELECTRO-CHEMISTRY.

Cupron Battery.—The "Elek. Zeit.," July 26, mentions an improvement in the Lalande copper-oxide-zinc alkali cell, recently exhibited in Germany and made by a German firm under the above name; the principal improvement seems to be the construction of the copper-oxide plates, the process, however, being kept a secret; it appears that these improved plates may be regenerated, that is, re-oxidised, by merely exposing them to the air; in the older forms the regeneration of the copper-oxide plates is said to have been a somewhat difficult matter.

Chloride of Lead Accumulator.—The Lond. "Elec. Rev.," July 27, contains an article by Mr. Andreoli, in which he claims to be the first inventor; he cites a number of other patents, showing that portions of the process are old; he believes it to be the best accumulator.

Alloys in Voltaic Circuits.—Attention is called in the Lond. "Elec. Rev.," August 3, to a paper by Mr. Laurie in the "Phil. Mag.," describing researches with a large number of alloys.

Impurities of Aluminum.—An Academy paper by Mr. Moissan, is published in "L'Elec.," July 21.

MISCELLANEOUS.

Electric Welding.—A paper by Mr. Dobson is reprinted at some length in the Lond. "Elec. Rev.," August 3, and somewhat more fully in the Lond. "Elec. Eng.," August 3. His experience is based on nearly three years' working with the Thomson system; he found that the power required had been very much understated, a two-inch iron bar having been thought to require 30 h. p. to weld, while he found it to require as much as 80; a table is given containing the electrical power, duration and the indicated power for a number of welds; a two-inch wrought iron bar required about 250 h. p. for about 250 seconds, a one-inch bar about 42 h. p. for 50 seconds, a one-inch Bessemer steel shaft slightly more than this, a one-half-inch Bessemer steel bar about 34 h. p. for about 30 seconds. Another table gives the results of experiments for detetrmining the strength of electrical and hand welds, which were tested by bending them; it was found important to anneal the bar for several inches on both sides of the welds; with smaller sizes he experienced little difficulty in bending the welded bars, while cold, around their diameter; some tensile strength tests showed an average tensile strength of welded bars equal to between 92 and 100 per cent. He states that the process is a thoroughly practical one; he found that there was not one out of 500 welds that turned out a failure or was even defective; his experiments showed better results than those obtained at the United States Arsenal; aside from the cost of wages, which is considerably less, the cost of power, royalty and depreciation bring the total cost considerably over the cost of the ordinary smith's weld; he states that in straightforward welds the total cost will be between 10 and 15 per cent. more than for the smith's, while for difficult work and delicate operations, the cost will be about one third that of smith's work; the loss of iron is only about one-twentieth; the real difficulty is not so much a question of economy as a method of securing an absolutely reliable result.

Bernardo Welding System.—In an article by Mr. Richter in the Elek. Zeit.," July 26, he points out the objections to welding by means of the arc and suggests certain improvements. He claims that this system adapts itself specially to those cases for which the Thomson and hydro-electric methods require too great an amount of energy; among the objections are that the fibrous structure is converted into a crystalline one, that the metal becomes hard and that some of the valuable properties of iron and steel are destroyed on being heated to such a high degree; he gives tables of the results of tests with a large number of welds, showing the tensile strength and the elongation, in some the iron was hammered and in others it was annealed; he states that there is no reason to believe that the hardness is due to the introduction of carbon from the arc into the iron, because the original softness, though not the original tensile strength, can be restored again by annealing; the process is specially adapted for such metals as copper, lead, tin and the noble metals, another objection lies in the use of an accumulator battery in parallel with the dynamo, which involves not only greater cost but greater loss of energy; he therefore suggest using a dead resistance in place of the battery, which can be cut out of circuit automatically while the arc is used, by a simple apparatus; if the dynamo can stand having the circuit opened completely, this reasistance will not be necessary; he claims that the loss in this resistance is less than that in the batteries; to reduce the momentary starting current he introduces a choking coil; he recommends connecting the engine with the dynamo by means of an elastic belt; a larger dynamo will be required when no accumulators are used.

Magnetic Chain Towing.—"La Lum. Elec.," July 14, publishes at considerable length the first part of a report by Mr. Fontaine on the magnetic adherence apparatus of Mr. de Bovet, which he calls the most remarkable magnetic device known; the present portion is devoted almost entirely to a description and discussion of the application to towing vessels by means of a chain, the adhesion between the chain and the driving machine being obtained by a magnetic device; only three metres of chain are required for the necessary adhesion, while with the old apparatus 40 metres were required; the system has been in use for 18 months and the results are so satisfactory that the vessels on the lower Seine are to be equipped with this system. Magnetic clutches are briefly referred to, a number of installations being cited in which they are used. In the continuation of the article in the issue of July 21, the apparatus for chain towing is described in detail, with the aid of a number of illustrations.

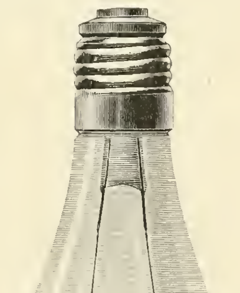
Efficiency of a Telephone Induction Coil.—A paper by Mr. Pierard is published in the "Bull. l'Assoc. de Montifiore," a full abstract of which is given in "La Lum. Elec.," July 14. The method of testing is to connect a microphone with a telephone first by means of one induction coil and then by means of another similar one whose secondary is connected with the secondary of another coil, the primary of which is connected with the primary of a third, the secondary of which is connected with the telephone; in the second case there are therefore three transformations, while in the first case there is but one; by means of switches the change from one set to the other may be made almost instantaneously; a given sound being produced in front of the microphone the distance of the telephone to the ear is increased until the sound is no longer heard; with these distances and certain simple formulas which he gives, the efficiency of the coil is calculated. He concludes that the efficiency does not vary appreciably with the charge and that it is somewhat less than 50 per cent. By increasing the number of coils until the sound disappears he calculates that the minimum amount of energy which actuates a telephone is equal to the $(0.44)^{19} = 0.00000016$ part of that in the primary circuit of the microphone.

Life Buoy.—According to the Lond. "Elec. Eng.," August 3, a German firm has devised a life buoy fitted with an electric lamp to be visible at night in water. It will sustain three persons at night in the water, weighs about one cwt. and contains an accumulator with gelatine material sufficient for an incandescent lamp for six hours; when hanging on the ship the current is switched off by the weight of the buoy, but when released the current is automatically switched on; the accumulator will last two months before it requires re-charging.

Detection of Liquor Frauds.—According to the Lond. "Elec. Eng.," August 3, a French journal, in reply to an offer of an award of $10,000 by the French government to the inventor of a simple and sure method of determining fraud in the production of alcoholic liquors, suggests that a knowledge of the electrical conductivity with that of the density, might be a sufficient means if the liquor be brought to the temperature of melting ice.

A New Incandescent Lamp.

It has been shown at some length in the columns of The Electrical World, that the economical life of an incandescent lamp may not exceed 450 hours. It is now well known that after that time there is a steady decrease in the candle power, and, in some cases, even an increase in the amount of the electrical energy consumed; in other words, after 450



Livgro Incandescent Lamp.

hours of use, the candle "burns at both ends," and the result is a decided loss in light and money to the consumer. It was proven that when lamps cost the consumer 35 cents each, it was a decided economy to smash the lamp after 450 hours of use, and that the desideratum now was either a cheaper lamp at the start or one that could be economically re-made. Dr. W. E. Forest, a physician of this city, has recently invented a lamp which, it is claimed, meets that want, as far as cheapness and effectiveness are concerned, the cost of the material in the lamp being a minimum.

The illustration shows the lamp complete, from which it will be seen that it is handsome in appearance, not differing in shape or size from "all glass lamps." A mica disk fits into the shouldered neck of the bulb, through the centre of which the mount passes. Molten metal, whose co-efficient of expansion is practically the same as that of glass, is then poured into the neck, sealing the bulb, and at the same time firmly holding the mount in position. It is thus seen that this makes a metal stopper lamp.

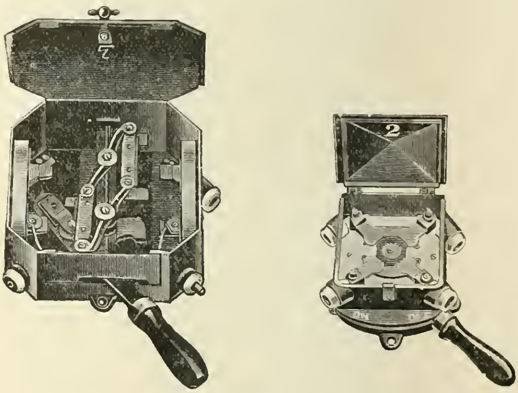
The advantages claimed for this lamp over others, are that it is handsome in appearance, not differing in shape or size from "all glass" lamps, and is more efficient. There is a double seal, consisting of a metal whose co-efficient of expansion is almost identical with that of glass, and a fusible, elastic cement reinforcing this metal, and no glass-blowing or skilled labor is required in making the mount or sealing the lamp.

A company of capitalists under the name of the Livgro Incandescent Lamp Company of Harrison, N. J., has been organized to exploit this lamp, and have fitted up a large factory at Harrison, N. J. Mr. C. F. Whittemore, formerly treasurer and superintendent of the Davis Lamp Company, of Springfield, Mass., takes charge of the factory. The president of the company is Mr. J. Livingston, the secretary and treasurer being Mr. Albert H. Gross, the son-in-law of Mr. James Seligman, the head of the well-known banking house of J. W. Seligman & Co. The executive officers of the company are at 50 Broadway, the salesrooms being in the Cable building, Broadway, corner Houston street, New York city.

High Tension Cut-Outs.

We illustrate several high tension cut-outs, manufactured by the Hope Electric Appliance Company, Providence, R. I., which unite the advantages of high insulation and quick-break with simplicity of mechanism and durability.

Fig. 1 shows a double-pole dead cut-out for primary alternating cir-



Figs. 1 and 2.—Primary Dead Switch and Arc Light Cut-Out.

cuits which is not only very rapid in breaking, but when open has a clear gap of more than an inch. The case is water-proof, so that the cut-out can be secured to a pole in the open air. A water-proof open

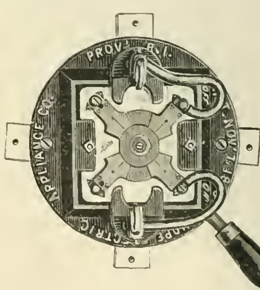


Fig. 3. Ceiling Hanger Arc Cut-Out.

air arc light cut-out is shown in Fig. 2, which is compact and has the mechanism insulated on a thick porcelain block. Fig. 3 illustrates a combined ceiling hanger and arc cut-out. This is secured to the ceiling by porcelain feet, and the mechanism is on a porcelain block, thus insuring a double insulation.

The Wenstrom Dynamo.

The two principal features of the dynamo we illustrate, manufactured by the Wenstrom Electric Company, Baltimore, Md., are the ironclad field magnets and the buried armature wires, the former of which are shown in Fig. 3 and the latter in Fig. 2, while the completed machine is shown in Fig. 1. The magnetizing coils are surrounded by iron in every possible direction, so that the iron core may collect all the lines of force from the coils, even those which are usually dissipated in the surroundings. It follows from this arrangement that the exciting power is less in this machine, all other things being equal, because the power is better utilized. Usually the space between the pole piece and the armature core must be sufficient, not only for the safe revolving of the armature at a high speed, but also for the conductors, which are wound transversely upon the core and in which the current is induced. This space introduces a high resistance to the magnetic lines of force, but in the dynamo illustrated the conductors are buried in grooves, or laced through holes transversely in the periphery of the armature, the distance between the pole piece and core being limited only to that small space required for the safe revolving of the armature. The resistance to the magnetic circuit is by this means reduced in a high degree, and it follows that the magnetizing power used for creating the necessary magnetism in the armature is also decreased.

The advantages of this type of dynamo are well brought out in a report by Gisbert Kapp, who, after a series of tests, writes as follows:

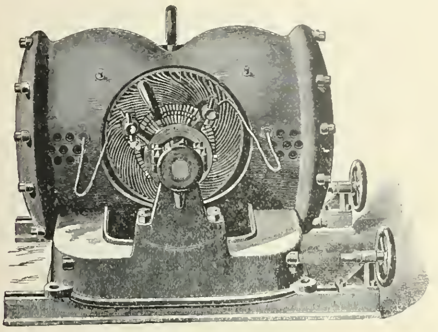


FIG. 1.—THE WENSTROM DYNAMO, SHOWING BRUSHES AND ARMATURE IN POSITION.

"The Wenstrom dynamo possesses many novel and remarkable points. It is very simply constructed and most substantially built, both as to electrical and mechanical details. Up to this time a machine has never been seen in this country which utilized all the magnetic forces as fully and undergoes so little loss of power as does the Wenstrom dynamo. It is impossible to utilize all such magnetic forces without the aid of two very essential points, which are the principal features of this machine. In all the best dynamos, as at present constructed, the manner of wiring the armature is such that it is impossible to bring the armature surface sufficiently close to the field poles to obviate the magnetic resistance, which it is very desirable to do. In

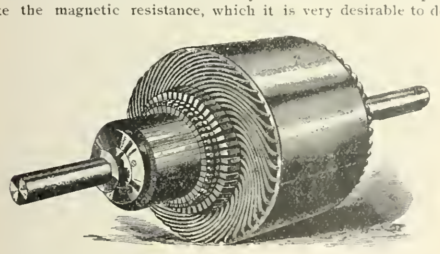


FIG. 2.—ARMATURE OF WENSTROM DYNAMO.

all the machines at present on the market, the old forms of field magnets have been strictly adhered to, and the currents produced by them generate magnetism in such a way that a large and valuable portion of it is generally lost. This, as will be readily perceived, it is very desirable to utilize, as, if it could be retained, more magnetism could be generated with less power. In the Wenstrom machine the desired end is attained by the peculiar construction of the field magnets and the cast-iron shell, which, while accomplishing the result demanded of it, also renders the dynamo more substantial and rigid in all its bearings. By this form the magnetic forces, which are generally lost in other makes of machines, are retained, while in the armature the two great obstacles are overcome by lessening the distance between the armature and the field, and by reducing the magnetic resistance to the core. The machine runs evenly and smoothly at extremely low speed. A careful examination of it will convince any one that it is the very best compared with other machines. In point of speed no machine can equal the Wenstrom, as it produces more current at low speed than any other can give at high speed. This dynamo has overcome some of the principal defects of other makes in speed, efficiency, weight and electrical and mechanical details." The compactness and convenient shape for handling of this dynamo, and the fact that the field coils are entirely

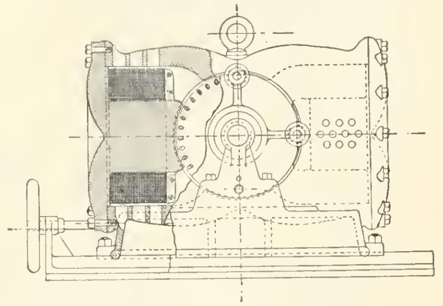


FIG. 3.—SECTIONAL END VIEW OF WENSTROM DYNAMO, SHOWING BEARINGS, COMMUTATOR, ETC.

contained within the iron body of the machine, obviate any risk of damage or breakage under ordinary circumstances in transportation or otherwise. All parts are made readily accessible for inspection or repairs. The armature can be taken out by simply removing one bearing. The field coils, which are wound on the heads of the machine, can very easily be removed by unbolting those heads.

Almost every dynamo of ordinary type is more or less subject to a wasteful and injurious heating in the iron core of the armature and pole pieces, due generally to the shape and the electrical conditions inherent in their design. This heating represents just so much energy absorbed or wasted in the production of a useless effect, and decreases more or less the efficiency of the machine. In some dynamos this heating is so intense after a long run as to imperil the safety of the insulation of the coils, and results in time in a rapid deterioration or destruction of the machine. The Wenstrom dynamo, on the other hand, can be run continuously for any length of time, and will show no such heating effect. This is due to the fact that from its construction there is an entire absence of wasteful Foucault currents.

New Electrical Devices.

Several patents have recently been issued to Mr. Henry B. Porter, of Porter & Co., Eighteenth street, New York City, for improvements in electrical apparatus, which involve some quite radical changes from current practice. The first relates to an electric bell, and consists first in the general arrangement and construction of the several parts so that greater simplicity and economy of construction are, it is claimed, secured, and second in the construction of the helix so that the necessary power can be obtained with considerable less current than ordinarily required.

Reference to the accompanying illustration will show the general plan of the bell. It will be seen that the core of the helix projects at both ends and that the armature is U-shaped, being pivoted between the sides of the frame and having its arms projecting over the extensions of the core. The core is made of iron tubing, the centre of which is filled with wood or other non-magnetic substance. Perhaps the chief merit claimed for this arrangement is that only one spool is required, and that this and the core, which may be found of ordinary soft iron tubing, are very easily made, and furthermore require a minimum of battery power to operate. The magnetic resistance of the circuit is very low and a more powerful pull for a given current is claimed. Another merit is that there being a comparatively small amount of iron in the core, the retention of magnetism is practically avoided, and for this reason the inventor intends to apply the same principle to telegraph instruments and other apparatus where residual magnetism is especially undesirable.

The other illustrations show a new type of motor, of whose practical success the inventor is very sanguine, claims being made especially for simplicity of construction and increased power. Fig. 1 shows a pair of these motors connected to a driving shaft and fly-wheel, and Fig. 2 is a vertical section of the same. Two helices are formed with their cores projecting at each end for the attraction of the armature, and are supported by a rod of non-conducting material passing through and extending within suitable seats in the frame to support the magnets in their proper position.

A double armature, consisting of two swinging frames pivoted to the upper end of the frame and formed in a manner to engage with the core at each end of the helix, and upon opposite sides, is applied to each magnet. One of the parts of the armature is of greater length than the other, and at or near its end engages with a horizontally arranged rod,

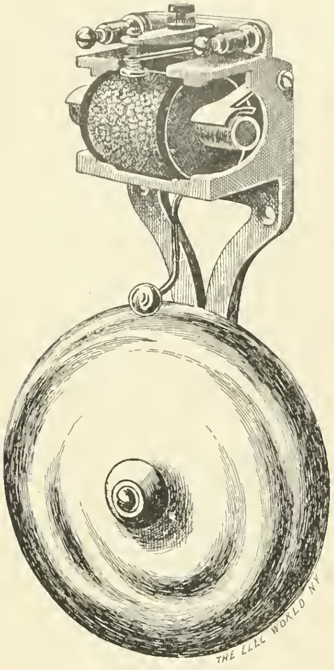


Fig. 1.—Improved Electric Bell.

which is loosely supported to slide in suitable bearings in order to bring the longer or principal armature better within range of the magnet. The longer the armature, the more leverage obtained. This engaging arm of the armature receives the combined motive power from the two parts of the latter when operated or attracted toward the core by means of a pivoted lever, which, at its opposite ends, is provided with anti-friction rolls adapted to engage with the corresponding face or surface of the two parts of the armature, in order that the same may be caused to move in unison when moving toward or from the core, and one be caused to move the other alternately as the same are moved in opposite directions, the short arm thus communicating its power to the opposite arm by means of this lever.

As shown in the illustration, a device is provided for automatically

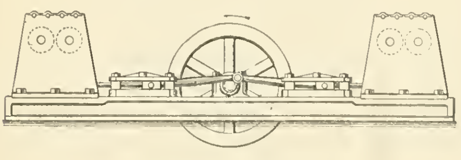


Fig. 2.—Porter Motor.

changing the current from one motor to the other in order that each may alternately draw the reciprocating connecting rods back and forth and rotate the connecting shaft. This device consists of a sleeve located upon the shaft in a manner to rotate with it, and also slide horizontally on it, the surface of which is divided into three sections, the central section being of non-conducting material and the end sections being formed of conducting and non-conducting material, as shown at each, forming half the circumference of the sleeve. The circuit from the battery is alternately changed from one motor to the other by means of two brushes forming one end of the circuit wires, which engage with the sleeve and alternately make and break the circuit as the conducting or non-conducting surface of the sleeve is in contact with the same during

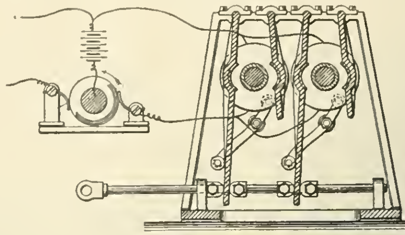


Fig. 3.—Porter Motor.

the revolution of the shaft. The operation of the shaft may be stopped or reversed by shifting the sleeve on the shaft to bring the proper surface into contact with the brushes, by means of a pivoted rod which engages therewith.

Automatic Oiling System.

A new automatic oiling system has been placed upon the market by the Wilson-Whiting-Davis Oiling Company, Broadway and Duane street, Mutual Reserve Building, New York city, which insures the oiling of machinery in a positive automatic manner, under a pressure sufficient to overcome all obstacles ordinarily encountered, and does away with all the manual labor usually required where hand-fed cups are used. At the same time a large saving of oil is claimed. The oil comes to the bearings perfectly clean, and the waste, which is very

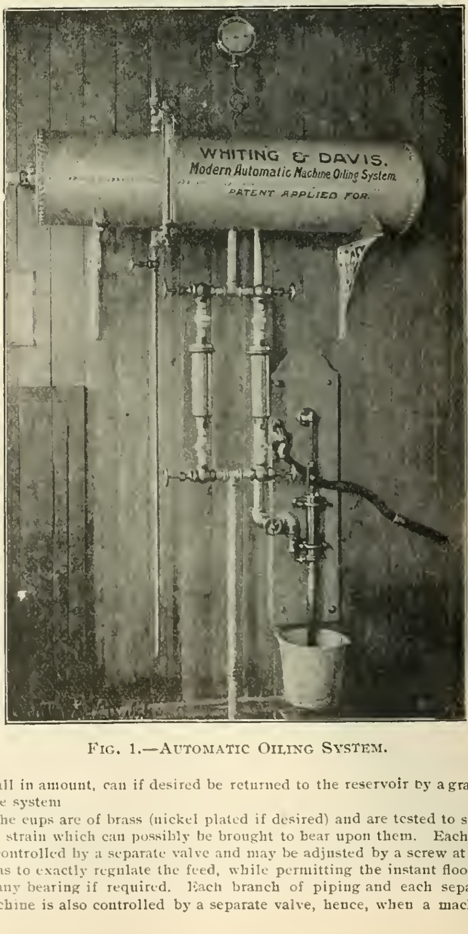


Fig. 1.—Automatic Oiling System.

small in amount, can if desired be returned to the reservoir by a gravity pipe system.

The cups are of brass (nickel plated if desired) and are tested to stand any strain which can possibly be brought to bear upon them. Each cup is controlled by a separate valve and may be adjusted by a screw at top, so as to exactly regulate the feed, while permitting the instant flooding of any bearing if required. Each branch of piping and each separate machine is also controlled by a separate valve, hence, when a machine

is idle only the one valve requires closing and all cups on its line cease feeding.

The accompanying cuts illustrate in a general manner the system and its application to electrical machinery.

Fig. 1 shows the complete apparatus required to operate the system. This consists of an iron tank of any required capacity, into which the oil is pumped from barrel, main reservoir or filter, as the case may be. Pressure, to an amount depending upon the requirements of the plan, is then applied to the tank by the same pump (which is shown near the floor line), forcing the oil through the filters below the tank into the main line of piping, thence through concealed branches to the different machines and cups. The inlet and outlet pipes to tank are also controlled by valves, as already mentioned in describing cups and branches. When the number of cups exceed 125, or machinery is on different levels, an automatic compressor is provided to further insure the constancy of the pressure.

Two filters are provided on the main supply pipe so as to admit the use of one in case of the other needing repairs or cleansing. This main

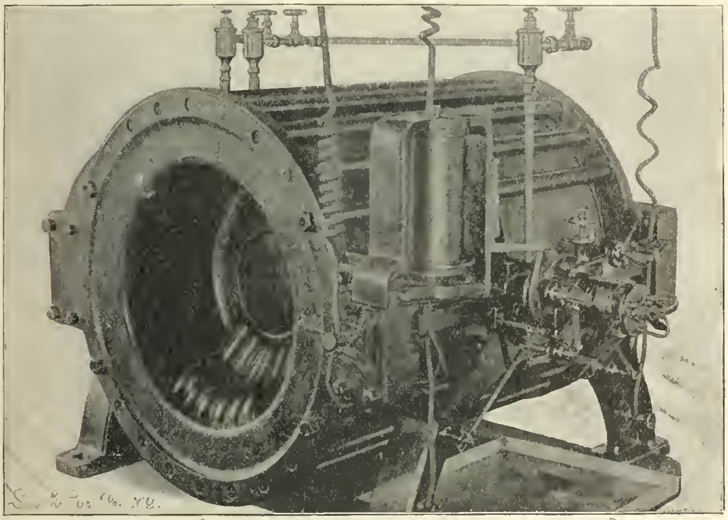


Fig. 2.—Oiling System Applied to Dynamos.

outlet inside the tank extends several inches above the bottom, to prevent the entrance of any foreign substance into the main feed line; when the gauge indicates the presence of such substances or water, the same may be drawn off by a sediment cock and branch, shown below tank. The tank may be placed at any point in the engine or oil room. The gauge and register may be on wall in sight of the engineer and the pump lever convenient to his hand. The variation in pressure, due to the gradual emptying of the tank, is so slight as to demand but a minute or so of attention twice a day.

The piping may be of iron or brass as required, and on fancy plants may be bent, thus doing away with many connections and couplings. This piping is so arranged as not to interfere in the least with the operations of the machinery.

Upon electrical machinery, proper insulators are provided and placed. Fig. 2 shows the system as applied to an arc light dynamo. One of the best illustrations of the efficiency of this system is the very complete installation in connection with the plant in the Equitable Building, New York City.

Storage Batteries of Large Capacity.

The New York Edison Electric Illuminating Company has contracted with the Electric Storage Battery Company of Philadelphia for a large storage battery installation.

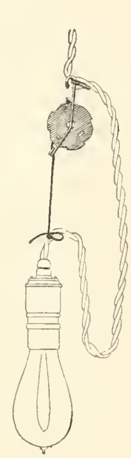
The installation will consist of 150 elements of chloride accumulators, type G, 41 plates, having a capacity of 8,000 ampere hours at 150 volts, normal rates, or a total capacity of 1,200 kw. hours.

The installation will be furnished with the most modern and complete appliances for the control and operation of the battery, and everything possible will be done to make it a model, and at the same time the most modern and complete battery plant ever installed.

The battery is to be installed immediately to be ready for the heavy winter load. This installation possesses more than usual interest on account of its large capacity and its evidence of the recognition on the part of American companies of the value of a storage battery plant. The New York Edison company has been using a battery of 2,000 ampere hour capacity for more than a year and has reached the inevitable conclusion that an auxiliary accumulator plant is desirable. This is practically the first instance where accumulators have been employed for this purpose on any considerable scale, and it is gratifying that the Edison company has given the contract, after the most thorough investigation here and abroad, to an American company in preference to a foreign firm.

Incandescent Lamp Adjuster.

We illustrate a very simple lamp adjuster, manufactured by Gibbs & White, 8 Hayward Building, Rochester, N.Y. As will be seen, it is not controlled by weight or friction, but by a positive double catch engaging on the rim of the reel. The catch is secured to the lamp cord by a fibre hook, thus insuring perfect insulation. It can be attached to a lamp by any one in a few seconds, and adjusts up to six fee. The



Lamp Adjuster.

weight is only two and a quarter ounces, and the catch disk 2 inches in diameter. The small spring used is merely for reeling the cord, and does not support any weight.

New Book.

ELECTRIC LIGHT INSTALLATIONS. Vol. II.—Apparatus. A Practical Handbook. By Sir David Salomons, Bart., M. A. Seventh Edition, revised and enlarged. London: Whittaker & Co. 1894. 318 pages, 296 illustrations. Price, $2.25.

This is the second of three volumes of a series on electric light installations, of which Volume I. is confined entirely to the subject of accumulators and Volume III. deals more particularly with the methods of working. The present volume relates to apparatus, though some information in regard to their use is included. The first chapter is principally devoted to gas engines, in regard to which much practical information is given, derived from the author's experience with his extensive private plant at Broomhill; a few pages relate to steam and oil engines and considerable space to engine accessories, as oil economizers, counters, speed indicators, etc. The next chapter describes and illustrates a number of types of dynamos, and a lengthy chapter on measuring instruments follows. Chapter IV. is on electric governors for maintaining a constant potential or current, of which two types are described. In Chapter V. switches and switchboards are dealt with, and the following chapter illustrates many forms of fuses, cut-outs, connectors and minor apparatus. Some pages on arc lamps make up Chapter VII., while the succeeding chapter is on practical applications, and from the numerous cuts and little descriptive matter looks suspiciously like padding.

While a greater portion of the book is purely descriptive, yet practical information of direct application is scattered everywhere throughout its pages, and we can unhesitatingly recommend these volumes to the owners and electricians of isolated electric lighting plants as the best of which we know for their purposes.

Financial Intelligence.

The Electrical Stock Market.

New York, August 18, 1894.

DUN'S REVIEW, of August 18, has the following: The new tariff bill, if signed by the President, as expected, provides a definite basis for business. No supplemental legislation is thought possible until next year at least. Large improvement has been expected from any settlement, the more because of a vast amount of business deferred from week to week in the hope of more definite conditions. The rush of such business, or even a part of it, might easily double transactions for a time. It is not to be overlooked that the effect of new duties upon many branches of industry and trade is problematical, and may be determined only after some months of experience, and meanwhile the serious injury to corn and some other conditions exercise a restraining influence. While it is not wise to look for a great "boom," there is warrant for a reasonable and prudent hopefulness.

GENERAL ELECTRIC has reached a higher quotation this week than it has the last six months. It closed to-day at 43 5-8. As already stated in these columns the burning of the Siemens & Halske plant gave a spurt to the stock, and the statements of increasing business and the bull feeling has continued to advance General Electric. General Electric bonds have also crept up until they are now quoted at 92, and preferred stock is now sold at Boston at 42½.

WESTINGHOUSE ELECTRIC. July orders were the largest in the history of the company and footed up $980,000. This amount includes the contract of equipment for the United Electric Light and Power Company of New York, amounting to several hundred thousand dollars. Shipments from the company's factory in July were between $500,000 and $600,000, and collections were of about the same amount, 80 per cent. of them being in cash. It is now thought that common stock dividends will be passed until the company is housed in its new works at Brinton. The board of directors will meet during the coming week, and probably some action will be taken on the dividend subject. Westinghouse common closed two points below last week's figures, while the preferred advanced 1½ per cent.

BELL TELEPHONE has had a week of fluctuations and closes at about the same figures it did a week ago. One day the stock dropped off two points, but as there were no new developments in the company's affairs, the drop was only attributed to a dull market.

FORT WAYNE STOCK is ruling a little stronger than it has, and the New York office reports a fair all round manufacturing business. Current rumor has it that the Fort Wayne is intending to enter the railway field as an active competitor of General Electric.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY paid a quarterly dividend of $1.00 per share on August 17. This Company is planning to do a considerable amount of underground work in the various cities of Massachusetts during the current year, and it has gained such a reputation in this class of work that members of the Louisville, Ky., city goverment have recently been inspecting the New England's plant and underground wire system at Boston.

AMERICAN DISTRICT TELEGRAPH stock has been more active than usual during the week and is offered at 45. The company paid a quarterly dividend of 1 per cent. August 17.

WESTERN UNION TELEGRAPH continues in activity and appreciation. It has made a net gain during the week of 1½ points and has sold as high as 90.

NEW YORK EDISON ELECTRIC ILLUMINATING is making slight advances. That this stock does not appreciate in accordance with its intrinsic value is said to be largely due to the number of foreign stockholders who are inclined to let go their holdings at any bad financial news from American soil. The stock is now ranging around par, but this is below the quotations of the illuminating properties in the larger cities. The higher rate of dividend paid in some of the cities of course makes better prices for the stock, though the New York compares well with all of the stocks, paying the same rate it does. The coupons of the first mortgage bonds, due September, will be paid by the New York Guaranty and Indemnity Company.

EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.—A statement was published during the week saying that this company's receipts, owing to economy in the consumption of light, had fallen off from $3,000 to $5,000 per month. This gives an erroneous impression of the true status of the company. There is always less light used at this time of year, and, with the prevailing dull times, the company's business is naturally less than it would be in midwinter. Compared with last year, however, the July net earnings for 1894 show an increase of $3,976, and the net earnings for the first six months of 1894 are $83,206.99, an increase of $15,687.99. The company has now 1,000 arc lights in operation for street lighting in Brooklyn.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	98½	100
* " " " Brooklyn	100	101	103
* " " " Boston	100	120	121
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2⅞	3
General Electric	100	43	44
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	33	34
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	1,000	107	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	92	93
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	199	200
*American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
*Erie Telephone	—	45¼	46
*New England Telephone	—	68	69
Gold & Stock Telegraph	100	100	102
*Mexican Telegraph	100	190	200
*Western Union Telegraph	100	89¾	89⅞

*Ex. div.

New Incorporations.

THE CROWN POINT ELECTRIC COMPANY, Crown Point, Ind., capital stock $10,000, has been formed for operating light, heat and power plant in Crown Point, Ind. The incorporators are Geo. K. Wheeler, E. S. Tice, O. W. Olsen.

THE LACKAWANNA VALLEY TRACTION COMPANY, Scranton, Pa., capital stock $400,000, has been incorporated to construct and operate passenger railways by motors, cables or other machinery. L. A. Watres, L. Amerman, P. S. Page, all of Scranton, are the organizers.

THE PITCAIRN, WILMERDING & BRADDOCK STREET RAILWAY COMPANY, Pittsburgh, Pa., capital stock $21,000, has been formed to construct and maintain an electric railway. The promoters are G. W. Barricklow, G. H. Garber and H. L. Castle, all of Pittsburgh.

THE SOLANO ELECTRIC LIGHT COMPANY, Benicia, Cal., capital stock $10,000, has been formed to do a general lighting and power business, using electricity and gas. T. McKay, M. Chisholm, M. McArthur, P. Fry, Benicia, and G. Frame, Elmira, Cal., are interested.

THE SANDUSKY VALLEY ELECTRIC RAILROAD COMPANY, Upper Sandusky, O., capital stock $10,000, has been formed to build and operate a railroad from Marion to Port Clinton. The interested parties are J. Q. Wirick, R. R. Dumm, F. E. Dumm, G. H. Roppold and T. Carroll.

THE ELECTRIC ADVERTISING COMPANY, San Francisco, Cal., capital stock $100,000, has been formed to do advertising by means of electrical and other devices. F. Brandt, E. L. Waibel, O. Waibel, G. A. Paul, G. L. Schneider, C. E. Fisher and A. R. Paul, San Francisco, are interested.

THE BOSTON AUTOMATIC FIRE ALARM COMPANY, Portland, Me., capital stock $250,000, has been formed to manufacture and deal in electric, fire and burglar alarms. The incorporators are E. S. Cowles, Jersey City, N. J.; Edwin Sheafe, Boston, Mass., W. O. Underwood, Lynn, Mass.

THE OHIO METAL COMPANY, Norwalk, O., capital stock $25,000, has been formed for dealing in and manufacturing metal goods, manufacturing gas and electric fixtures, etc. The incorporators are E. F Rowley, W. H. Price, Jas. G. Gibbs, Geo. T. Thomas, N. O. Allen, F. A. Powers, R. K. Rood.

THE AKRON INSULATOR & MARBLE COMPANY, Akron, O., capital stock $20,000, has been formed for manufacturing and dealing in insulators, tubing, electrical machinery, appliances, goods, specialties, etc. The incorporators are Jas. P. Loomis, Albert L. Bouman, Adelbert L. Daniel, Jas. P. Hemphill, Samuel C. Dyke.

THE GILMORE WATER & ELECTRIC LIGHT COMPANY, Independence, Ore., capital stock $30,000, has been formed to furnish water for domestic and other purposes, electric light, heat and water, or electric or other power. The incorporators are L. C. Gilmore, J. S. Cooper, J. A. Veness, D. B. Taylor, I. M. Vanduyne, A. S. Locke.

THE NEW YORK STANDARD CONSTRUCTION COMPANY, New York, capital stock $50,000, has been incorporated by Eugene Berry, Rutherford, N. J.; R. Krouse, Santiego; M. Sugarman, Brooklyn, and W. T. Zandt, New York, N. Y., to construct electric light plants and railways as well as to do various other kinds of construction work.

THE SAVOY ADVERTISING-VENDING MACHINE COMPANY OF NEW JERSEY, Jersey City, N. J., capital stock $200,000, has been formed to make, use and deal in all kinds of mechanical and electrical machines, instruments, etc. The incorporators are John I. McDavitt, of Pompton, N. J., Geo. F. Rundle, Sparkhill, N. Y., Jerome Bradley, N. Y. City, N. Y.

THE WESTMINSTER & UNION MILLS ELECTRIC RAILWAY COMPANY, Westminster, Md., has been organized by T. H. Shriver, of Union Mills, C. E. Stewart, W. B. Thomas and others of Westminster, and Frank Brown, of Baltimore, president of the Baltimore Traction Company. This company proposes to construct an electric road from Baltimore to Gaithersburg.

THE CO-OPERATIVE ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to acquire, sell, lease or operate railways, to buy, use or operate franchises for the same, to manufacture, sell or operate patents, protecting electric railways, equipments, etc. The incorporators are: Morris S. Evinger, Chas. E. Nurnap, Isaac T. Dyer.

THE LANCASTER RAILWAY CONSTRUCTION COMPANX, Trenton, N. J., capital stock $100,000, has been formed to build, construct and furnish material for the construction of electric and steam railroads. The incorporators are Henry Baumgardner, Michael Reily, Geo. N. Reynolds, John E. Hubley, Frank H. Steacey, David B. Shenk, Lancaster, Pa., Hugh E. Grilley, Allentown, Pa., Theo. Mace, Trenton, N. J.

Special Correspondence.

New York Notes.

New York, August 20, 1894.

MR. BRAINARD RORISON was in the city last week and left on the steamship Paris, on Wednesday, for a visit to his family in France, his children being in school there.

New England Notes.

Boston, August 18, 1894.

REYNOLDS T. WHITE, widely know as the inventor of White's elevated railroad system, died at his home in Medford last week.

THE W. S. HILL ELECTRIC CO., Boston, Mass., reports business greater than ever in its history. This factory is kept busy at nights upon orders.

MR. FRANK S. DE RONDE, the popular general sales agent of the Standard Paint Company, of New York, was a Boston visitor this week, favoring this office with a call.

MANAGER EDWARD H. OAKES, of the Lynn Electric Company, has been arrested on the charge of having set fire to the Strout building on July 21, which nearly resulted in the loss of five lives.

MR. W. C. BRYANT, of the Bryant Electric Co., Bridgeport, Conn., was in Boston this week. He was accompanied by his wife, but notwithstaning this fact he could not help looking after business just a little. This is one of his characteristics.

MR. GEORGE L. WILEY, eastern manager of the Standard Underground Cable Company, of Pittsburg, Pa., looked in upon us this week, his countenance beaming with its usual cheerfulness. We can't remember to have ever seen him otherwise, which fact, coupled with his indomitable energy, has won for him extraordinary business success.

MR. D. A. ANDREWS, JR., AND MR. C. B. PRICE, treasurer and general manager respectively of the Pettingell-Andrews Company, of Boston, are enjoying their vacations this summer in a very sensible and business-like manner. One of them can always be found at the office looking after the rapidly increasing business of the company, and yet every other week each takes a few days' outing and enjoyment.

MR. GEORGE E. RUSSELL, bookkeeper and cashier for the Pettingell-Andrews Company, of Boston, is at present enjoying his vacation in New Hampshire. He certainly deserved it, and we trust it will abound in uninterrupted pleasures and enjoyments. Mr. Russell has been connected with the Pettingell-Andrews Company for nearly five years, during which time he has always been faithf 1 in the discharge of his duties, has made hosts of fri nds, and enjoys the entire confidence of the officials of the company.

WEYMOUTH, MASS., RAILWAY ENTERPRISE.—It is stated that the directors of the Rockland & Abington Electric Street Railway Company have offered to give up a franchise granted them by the selectmen of Weymouth to extend their tracks from South Weymouth to East Weymouth to a company of Weymouth citizens who desire to construct a road. At East Weymouth the new company proposes to connect with a line which is to run to Nantasket Beach.

NEW STREET RAILWAY.—A corporation to be known as the Milton & Boston Street Railway, is being formed at Milton with a capital stock of $50,000. The company will construct and operate by electricity a street railway from East Milton to Mattapan, a distance of about four miles, and connect with the Dedham street railway at Mattapan. A preliminary organization has been made with these directors: Albert A. Brackett, John R. Lawrence, D. J. Brown, William H. Rice, of Milton; John A. Duggan, Thomas H. McDonnell and Walter P. Pinel, of Quincy.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., has issued invitations for its sixteenth annual Rhode Island Clam Dinner, which will be held next Saturday, August 25, at Haute Rive. This is one of the events always heartily welcomed by the electrical fraternity, as a good, solid day of pleasure is assured and enjoyment and good fellowship reigns supreme. Old friends meet again who might not otherwise, and new friends are always made—facts which have endeared genial Eugene F. Phillips to all who have ever enjoyed his kindness and hospitality.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, of Hartford, Conn., is making important and extensive additions to its factory, which is being increased to the height of three stories, the building to be of brick, lighted on all sides, amply provided with elevators and all modern sanitary appliances for a first-class workshop. The extension of its plant is for the purpose of getting its various departments together and affording ample accommodations for its growing business. It is expected that the new building wil be ready for occupancy October 1st.

OPPOSED TO ELECTRIC LIGHTS.—A large portion of the summer residents at Marblehead, Mass., do not want electric lights there. The town, at the annual town meeting, voted to purchase an electric lighting plant to light the streets and public buildings, and as the Neck is included in the town, enough poles and wire were ordered to equip it with lights. The contracts were signed and the work of erecting the poles began. Now comes this unlooked for opposition, and the committee is in doubt what to do. If a majority of the property owners do not want the lights the committee will not insist upon erecting them. One of the reasons they advance is that the electric glare will obstruct the view of the harbor and the ocean.

HANOVER, N. H., STREET RAILWAY.—The stockholders of the Hanover Street Railway Company held their first meeting at Union Hall, Assinippi, last evening, to form a permanent organization. A code of by-laws was adopted, and the following Board of Directors elected: Charles H. Killam, Frederick B. Jacobs, Frank S. Alger, Jedediah Dwelley, Charles L. Stevens, Herbert L. Curtis and Frederick H. Curtis. The directors elected Charles H. Killam president, Frederick B. Jacobs, clerk, and Frederick H. Curtis, treasurer. These officers were chosen a committee to confer with the Rockland & Abington Street Railway officials in regard to the extending of that road to the Hanover line, and also to negotiate with the Abington & Rockland Electric Light and Power Company.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the shipment last week of a car load of electrical apparatus, consisting of one 250-light dynamo and ten 3 h.p. Manchester type slow speed motors, with special starting boxes, to the Massachusetts State Insane Asylum at Danvers. The motors will be used for operating ventilating fans throughout the building, the whole installation being in the hands of G. M. Angier & Co., of Boston, New England contractors for Mather apparatus. The company also reports the sale, through Harry S. Smith & Co., of Philadelphia, of two 45 kw. direct connected dynamos for the Bartram apartments of that city. These dynamos are to be of the new Mather multipolar type, directly connected to Woodbury engines, and when completed will be one of the finest direct connected plants in Philadelphia.

News of the Week.

Telegraph and Telephone.

LOCKPORT, N. Y.—Mr. Edward F. Griffin is organizing a telephone company, intending to install a plant of 300 telephones. He is in the market for material for its construction.

BALTIMORE, MD.—The City Subway Commission met to pass upon plans, etc., submitted by Engineer Hill to place the wires of the police and fire alarm telegraph systems underground. It is contemplated to make the City Hall the centre of the conduit system. The Council has appropriated $100,000 for the work of burying the wires.

Electric Light and Power.

LEECHBURG, PA.—The city will soon enjoy the electric light.

WAUKON, IA.—The council has been petitioned for a franchise to supply the town with electric lights.

TARRYTOWN, N. Y.—St. Teresa's Roman Catholic church is being renovated and will be lighted by electricity.

READING, MASS.—At a special meeting held in Reading it was voted to establish a municipal lighting plant at a cost of $50,000.

PHILADELPHIA, PA.—A two-story structure is to be added to the Howard Hospital. It will be heated by steam and lighted by electricity.

NEWARK, N. J.—The Newark Electric Lig ht & Power Company has begun the work of erecting a large power house 75x72, to cost $12,000.

SALT LAKE, UTAH.—The City Council has under consideration the proposition of L. C. Trent & Co. to put in an electric plant at a cost of $100,000.

LITTLE ROCK, ARK.—The Brown Electric and Machinery Company has closed a contract for an electric light plant to be installed at Lockhart, Tex.

WAUSAU, WIS.—The council has entered into a contract with the Wausau Elecric Light Company for a period of five years, at the rate of $80 per light.

WAUKON, IA.—Mr. M. B. Hendricks has been granted the exclusive right to erect and maintain an electric light plant in Waukon for a period of seven years.

OGDENSBURG, N. Y.—B. C. Algie and others are advocating the purchase of a municipal plant and desire information as to apparatus from manufacturers.

HARTFORD, CONN.—The Housatonic Electric Light Company has been organized. Milo B. Richardson, of Salisbury, has been elected president of the company.

HOT SPRINGS, ARK.—The Hot Springs Electric Light Company is to put in a new 1,500-light alternator, slow speed preferred. W. M. Wilson is the superintendent.

BETHANY, MO.—The Franklin Electric Company, of Kansas City, has been awarded the contract for the erection of an electric light plant and water works for the city.

CLEVELAND, O.—The Cleveland General Electric Company has amended its charter, changing the name of the corporation to that of the Cleveland Illuminating Company.

WICHITA FALLS, TEX.—The Consolidated Engineering Company, St. Louis, Mo., has been awarded the franchise for the establishment of an electric light plant and water works system.

JACKSONVILLE, FLA.—The city council has instructed the city attorney to draw up an ordinance authorizing the board of public works to purchase and erect an electric light plant at a cost of $75,000.

WYOMING, PA.—At a regular meeting of the Wyoming Borough Council, an ordinance was presented and read for the increase of the borough indebtedness to the amount of $15,000 for the erection of an electric light plant.

WATCH HILL, R. I.—There has been some talk during the week about lighting the place with electricity. It is probable that the Pawtucket Valley Street Railway Company will put in an electric lighting plant next year.

CLEVELAND, O.—The new building to be erected by the New England Company will be provided with a separate electric plant. The contract for the building has been let to Norcross Bros., Worcester, Mass. Many parts of the work will be sublet.

OTSEGO, MICH.—Otsego is to have electric lights. George C. and B. A. Nevins have purchased the Pine Creek flouring mill, and will put in a dynamo and bring the electricity here, a distance of one mile, and will distribute it over the village as wanted.

WORCESTER, MASS.—A business block will be built by the State Mutual Life Insurance Company at Maple and Main streets. A large area will be left open on which it is possible that after the block is completed the land may be utilized for a power house and electric plant.

MANLIUS, N. Y.—An electric light franchise has been granted by the trustees of the village of Manlius to Edward Kanaley, who is organizing a company to put in an electric light plant at Edwards Falls, and furnish light for East Syracuse, Fayetteville, Eastwood Heights, Manlius and other villages.

THE CONSOLIDATED ENGINEERING COMPANY, St. Louis, Mo., has closed a contract with the city of Paducah, Ky., for a municipal arc street lighting plant. Standard Electric Company's dynamos and Hamilton Corliss engine will be installed, the city of Paducah to furnish real estate and buildings. There will be 120 2,000-c. p. arc lights in the streets.

EAST PROVIDENCE, R. I.—A plant to manufacture electricity is being located on what is known as Bower's Cove, on the lower part of the East Providence side of the river. The device is the invention of Mr. John Wild, of this city, and application has already been filed for a patent. Mr. Charles A. Brown is associated with him, and they are organizing a stock company.

The Electric Railway.

CHARLESTON, S. C.—Julian Fishurn is seeking a franchise from the council for an electric road.

ROME, N. Y.—The Rome City (N. Y.) Street Railway Company will adopt electric motive power on its system.

GREENVILLE, TEX.—The city has granted a franchise for an electrical railroad. The mayor can give particulars.

BENTON HARBOR, MICH.—$1,300 bonus was raised by citizens to extend the electric street railway one mile to the eastern city limits.

NEWARK, N. J.—A new electric railway will be built through Kingsland streets, Franklin avenue and Centre street, to Washington avenue.

KEY WEST, FLA., is to have an electric railway. J. J. Philbrick has obtained a charter and will build eight miles of road and equip it for electric cars.

COLUMBUS, GA.—The Columbus Railroad Company, operating dummy and horse-car lines, will, it is expected, soon take steps for changing to electric power.

HAVANA, CUBA, offers an excellent opening for an electrical railway. Electric cars would prove a paying investment with the gay and pleasure-loving Cubans.

LITITZ, PA.—A franchise has been granted the Lancaster and Lititz Electric Railway Company to lay tracks and operate an electric railway in the borough of Lititz.

WILLIAMSPORT, PA.—Residents and land owners in Nippenose Valley are agitating the project of constructing an electric line from Nippenose to Williamsport.

NEW ORLEANS, LA.—Engineer Brown has completed specifications for the work necessary to change the lines of the St. Charles Street Railroad Company to electric power.

COLUMBUS, GA.—The North Highlands Railroad Company has been granted a franchise for the extension of its line, and engineers are now at work surveying the route.

PATERSON, N. J.—Sheriff Rea says that the promoters of the Paterson Company have already signified their intention of extending the tracks of the North Main street line to Readville.

MILFORD, N. J.—Milford's council has granted the right of way for the electric road, and it may cross the river at Milford and get to Carpenter's Point, on the Jersey side of the river.

JOPLIN, MO.—The Joplin Electric Railway Company proposes to extend its line to Galena, Kas., a distance of eight miles. The Joplin Electric Railway Company is owned by St. Louis capitalists.

SWARTHMORE, PA.—Winfield Johnson and Benjamin F. Wickersham have secured the contract to build the Philadelphia & Delaware County Electric Railway from said place into and through Media.

MILFORD, CONN.—The application of J. S. Brown et al., of Milford, for a charter to build an electric road, is a substantial evidence that Bridgeport and New Haven are soon to be connected by the trolley.

WEST ORANGE, N. J.—The Suburban Traction Company has offered to grade the proposed street to be known as Meadowbrook Lane, if the Board would give it a franchise to operate an electric railway thereon.

ST. AUGUSTINE, FLA.—An officer of the St. Augustine Electric Railway states that the road would surely be started within thirty days. The starting point of the road will be at the intersection of King and St. George streets.

ROYERSFORD, PA.—Royersford is the objective point of two trolley lines, namely, the Pottstown line and one from the county seat, but whether either will be given the franchise to this borough entirely remains to be determined by the town council.

HAVERHILL, MASS.—Charles Corliss, of Haverhill, Mass., declares that at the next session of the New Hampshire Legislature he will ask for a charter for an elevated or an electric railway, which will begin at Haverhill, Mass., and extend to Nashua.

PAWTUCKET, R. I.—At the meeting of the Lincoln town council a petition was presented from the Moshassuck Railway Company, asking for the right to extend their line and to operate the cars with electricity. Superintendent Clark may be addressed.

WAPPINGER'S FALLS, N. Y.—A road connecting Wappinger's Falls with Fishkill will next be constructed. M. Hinckley, the president of the road, it is definitely stated, is one of the representatives of certain influential capitalists who are putting the enterprise through.

CHEVY CHASE, MD.—The Chevy Chase & Kensington Railroad Company has been organized to build an electric railway from the present terminus of the Rock Creek Railway to Kensington. Oliver R. Harr is president, Alfred Ray, vice-president, and W. H. Walker, secretary.

ATLANTA, GA.—Mr. Walter H. Lenhart, Southern agent for the Standard Electric Company of Chicago, presented a petition asking for the right to put electric light wires, erect poles and put in conduits along Whitehall, Pryor, Loyd, Broad, Decatur and Peachtree streets for the purpose of furnishing light and power. The petition was referred to the electric light committee.

Trade and Industrial Notes.

MESSRS. H. B. COHO & COMPANY, 203 Broadway, did a very quick piece of work last week. They received an order for a 500-light Mather generator at 4 o'clock one afternoon, telegraphed to their factory at Manchester, Conn., and next evening at 6 o'clock the dynamo was carrying its full rated load.

MR. S. W. RUSHMORE, 126 Liberty street, has increased his facilities at his factory in Jersey City for the manufacture of his high tension arc lamps, by the addition of several special and expensive machines. He has discontinued the manufacture of the constant potential arc lamps, having sold the patent rights to the General Incandescent Arc Light Co.

W. S. BELDING, Chicago, the well-known manufacturer of commutators, has recently formed a company to be known as the Belding-Hayward Company, with Mr. E. L. Hayward as president. The new concern will occupy the offices of Mr. Belding, 48, 50, 52 North Clinton street, and will push the sale of the specialty more extensively than ever before.

THE NATIONAL CONDUIT MANUFACTURING COMPANY, Times Building, New York, has just closed a contract with the Boston Electric Light Company, of Boston, Mass., for all its subway work for this year, and has also contracted with the Nebraska Telephone Company for all the conduits for the Lincoln subway, which is to be built this year.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has received some pretty good orders for I. X. L. triple braid wire during the last week, among the number being one for thirteen miles and one for ten miles, large sizes. This wire is coming into prominent notice in the West, being already a favorite in the East, and the Metropolitan Electric Company carries a large supply on hand to enable it to fill orders without delay.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., among recent contracts, reports two 100 horse-power compound condensing engines, complete, with boilers, condensers, pumps and heaters, to the village of Napoleon, O. Also two direct connected high speed automatic engines to the St. Denis Hotel, New York, and one 250 horse-power slow speed automatic engine to the Firmenich Manufacturing Company, of Marshalltown, Ia.

MR. HENRY HANDSHY, electrician of the San Antonio Electrical Supply Co., of San Antonio, Texas, has secured the contract for the wiring and completion of all electrical work of the Opera House at San Luis Potosi, Mexico. The building is owned and controlled by the Mexican government, and when finished (about November, 1894) will cost a trifle over $1,000,000. The building covers an entire block and has been under construction for over five years. There are to be 600 incandescent lights, besides a number of arc lamps.

J. ELLIOT SHAW & Co., 632 Arch street, Philadelphia, have issued a 144 page catalogue of household electrical supplies, containing illustrations and prices of almost every conceivable form of house goods. The last 16 pages are devoted to general remarks on batteries, electromotive force, resistance, etc., directions for setting up and maintaining batteries and gas-lighting apparatus, wiring estimates for annunciators, burglar alarms and electric gas-lighting, diagrams of bell circuits and much other information of value to electricians.

THE CHICAGO OFFICE of the Ball Engine Co., Erie, Pa., in the Rookery Building, have had, even in these depressing times, a fair amount of business. Among recent sales are the following: Peninsula Electric Light and Power Co., Houghton, Mich., one 350 h. p. tandon compound engine; Hotel Newcombe, Quincy, Ill., one 60 h. p. engine; Howe Pump and Engine Co., Ladd, Ill., one 50 h. p. engine; Industrial Home of the Blind, Chicago, one 80 h. p. engine, direct connected to general electric dynamo; Norton Bros., Maywood, Ill., two 150 h. p. Cross compound engines.

SIEMENS & HALSKE ELECTRIC COMPANY, Chicago, has, since the fire, closed six contracts for various classes of machinery, of which the two most important are the Hotel Savoy, New York, for a large lighting plant, and Franklin MacVeagh & Co., in Chicago, for a power transmission plant. The works of the Grant Locomotive Company have been leased, and are now in operation as an electrical manufacturing plant. Several 1,000 h. p. dynamos were commenced August 13, and before the end of the month 1,000 men will be at work in the new shops on orders aggregating 20,000 h. p. of electrical machinery.

THE GILLILAND TELEPHONE COMPANY, of Chicago, is meeting with good success in the introduction of its telephone. The instrument is made in a substantial manner and is artistic in form, consisting of a magneto mounted on a backboard, with desk, bi-polar magneto transmitter, and telephone receiver with cord, and is sold outright at a fair price. Its central office and exchange system for towns and small cities is complete and comprehensive. The president, Mr. W. H. McKinlock, and the general manager, Mr. J. J. Nate, have spent the greater portion of their lives in telephone and kindred electrical interests, securing therefrom broad and valuable experience, which are very necessary factors to the advancement of telephone work.

EDWARD P. THOMPSON, M. E., 5 Beekman street, New York, announces that he has associated with himself Professor William A. Anthony, whose professional record is so well known that it is almost superfluous to refer to it. He was professor of physics at Cornell University for 15 years, where he planned and equipped the physical laboratory building, and organized and had charge of the department of electrical engineering, and is a past president and member of the American Institute of Electrical Engineers and Fellow of the American Association for the Advancement of Science. Since the time of his resignation from Cornell University, Prof. Anthony has had much experience in designing and building apparatus and machinery for electric lighting and power transmission, and as a consulting electrical engineer and expert in technical and patent matters. For the greater portion of this period he was engaged as the consulting electrician of the Mather Electric Co. He is the author of many papers presented before technical societies and in scientific periodicals, and, with Prof. Brackett, of Princeton, of a text-book of physics. Few men in America are as competent to undertake all classes of electrical expert work, both commercial and scientific.

THE PLANT OF THE MATHER ELECTRIC COMPANY, covering a number of acres, is situated in Manchester, Conn. (three hours on the train from either New York or Boston), directly on the main line of the New York & New England Railroad, which, together with a sour track running directly into their erecting shop, allows the company to load heavy generators directly on the cars and gives them the best of facilities. The company recently completed an extension to its plant in the form of an iron building, 500x50 feet, for an erecting shop, constructed by the well-known Berlin Iron Bridge Company, of East Berlin, Conn., and fitted with a fifty-ton Shaw electric traveling crane, which, together with a large amount of new machinery which the Mather Company has recently installed, consisting of heavy planers, boring mills, radial drills, lathes, etc., enables the company to handle large generators up to 500 klm., and larger in capacity. The Mather Electric Company is making a specialty of both belted and direct connected work especially for railway and power purposes. Its facilities for testing generators, from the smallest to the largest, under most severe conditions, are second to none, its steam plant being especially arranged and

adapted for this purpose. The Mather Company already contemplates another extensive addition to its plant in the early future, to accommodate large work and new battery boilers and engines, especially for testing this class of apparatus. The entire plant of the Mather Company is operated by electric motors, sizes varying from five to fifty h. p., which system of transmission and sub-division of power have been found exceedingly satisfactory and economical in the operation of the works.

Business Notices.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 31, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

594,305. ARC-LAMP POST; Richard B. Bowker, New York, N. Y. Application filed June 22, 1894. The combination in an arc lamp support of a hollow post or standard, two arc lamps supported at the upper part and a resistance at the base thereof; the said lamps and resistance being connected in series and the said resistance and circuit conductors being wholly inclosed within said post.

524,343. ELECTRICAL CONDUCTOR; Edwin D. McCracken, Alpine, N. J. Application filed November 29, 1893. An electrical conductor having a covering consisting of a strip or strips of paper, composed of pure vegetable fibre, applied in its unchanged fibrous condition, the paper forming of itself an insulating covering and being dry and coated to render it practically anhydrous.

524,357. ELECTRIC ARC LAMP; Otto Hans Swoboda, New York, N. Y. Application filed July 19, 1893. In an electric arc lamp, the combination with a shunt across the arc nominally controlling the feed mechanism, of a second shunt across the arc controlling a nominally open circuit including in series a resistance and a coil about the feed controlling shunt magnet whereby when the arc is broken the lamp resistance is thrown around the arc and energizes the magnet which controls the operation of the feed mechanism.

524,361. METHOD OF AND APPARATUS FOR DETECTING AND MEASURING INFLAMMABLE GASES; Benjamin C. Tilghman, Jr., Philadelphia, Pa. Application filed March 14, 1893. In an apparatus for detecting the presence and amount of inflammable gases and vapor in the air, the combination of a source of electrical supply, a circuit connected with the source of the electrical supply, a conductor of relatively high resistance arranged in said circuit and adapted to change its resistance under the influence of the electric current and any inflammable gas or vapor in the air, and an independent indicator for showing such changes of resistance.

524,366. ELECTRIC RAILWAY SYSTEM; Theodore B. Wilcox and Henry Wilcox. Application filed August 1, 1893. A surface plate for electric railways, provided with a box in which a magnetic contact-maker is adapted to reciprocate, in combination with a magnet, operating outside the plate, for causing the reciprocation of the said contact-maker, the exposed portion of said plate consisting of parts made respectively of magnetic and of non-magnetic material insulated from each other.

524,367. ELECTROMAGNETIC CONTACT-MAKING DEVICE FOR ELECTRIC RAILWAY SYSTEMS; Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Application filed August 1, 1893. An electro-magnetic contact-making device, having its contact surfaces surrounded at the time of contact only by soft rubber whereby any water which may have accumulated upon the co-operating contact will be rendered harmless against causing injurious leakage.

524,368. ELECTRIC RAILWAY SYSTEM; Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Application filed August 16, 1892. In an electric railway system, a series of exposed magnetic surface plates arranged along the railway track, in combination with a motor car carrying an endless chain, a portion of which is in proximity to the said chain, the said magnetic devices being just as far apart along the length of the said chain as the said surface plates are distant from each other.

524,373. REGULATION OF DYNAMO-ELECTRIC MACHINERY; Edward M. Bentley, Boston, Mass. Application filed December 26, 1890. In a motor regulator the combination with a circuit closer of a choking coil adapted to be included in the motor circuit, means for automatically cutting out the said coil and additional means for varying the counter-electro motive force of the motor.

524,374 BATTERY-CHANGER FOR ELECTRIC LIGHTS; Charles Bernhardt, Chicago, Ill. Application filed November 23, 1891. The combination with a normally closed circuit, a battery lying therein, and a movable device operated by the breaking of the circuit of a second battery, and a switch operated by said movable part, and adapted, when so operated, to connect one of said batteries with said circuit.

524,376. COMPOUNDING MOTOR-GENERATORS; James Burke, Schenectady, N. Y. Application filed June 5, 1894. In combination, a motor-generator having its armature motor-winding in series in the primary circuit and its field-magnets in shunt to the motor winding, and a second or auxiliary counter electro-motive force machine having an armature distinct from that of the main machine, such armature being in series in the primary circuit, and its field magnets having a winding in shunt in its armature and a differential series winding in the secondary circuit.

554,378. SYSTEM OF ELECTRICAL DISTRIBUTION; Thomas A. Edison, Llewellyn Park, N. J. Application filed December 6, 1886. In a system of electrical distribution, the combination of a source of current of high tension, two feeding circuits extending therefrom, each including the primary coils of a tension reducing converter, a circuit including translating devices in multiple series, a conductor from the secondary of one converter extending to said translation circuit, a conductor from the secondary of the converter in the other feeding circuit, a conductor extending from between the translating devices to one joining the two secondaries, and means for separately regulating the two feeding circuits.

524,381. SYSTEM OF POWER DISTRIBUTION AND REGULATION; John W. Gibboney, Lynn, Mass. Application filed October 21, 1893. In a system of power distribution the combination with two or more independently operated plants, such as mills or factories, of a dynamo electric machine installed at each of said plants and adapted to co-operate therewith, and an electric circuit connecting said dynamo electric machines in parallel.

524,382. RHEOSTAT; Albert B. Herrick, Schenectady, N. Y. Application filed May 22, 1893. In a rheostat, a fuse included in the circuit of current-carrying capacity greater than that of the resistance wire and adapted to break the circuit when the heat of the bos is excessive.

524,383. BUS-BAR SWITCH FOR CENTRAL STATIONS; Albert B. Herrick, Schenectady, N. Y. Application filed June 9, 1894. A system of bus-bar switches for a central station comprising bus-bars, switches adapted to connect the bus-bars in different combinations, switch-boards located in different combinations, switch-boards located in a gallery, and mechanical connections between the switches on the bus-bars and the apparatus located upon the switch-boards in the gallery.

524,384. DOUBLE-THROW SNAP-SWITCH; Edward M. Hewlett, Schenectady, N. Y. Application filed July 2, 1894. A double-throw jack-knife switch, comprising a central blade, two outer blades, and a spring connected from one of such outer blades to the other, the outer blades having cut-away portions pivoted to the central blade and adapted to make positive contact therewith after a definite arc of movement.

524,385. CONTROLLER FOR ELECTRIC MOTORS; Joseph H. Jenkins, Lynn, Mass. Application filed February 3, 1894. A controller for electric motors comprising an actuating shaft or spindle mounted in suitable bearings, a circuit modifying device carried by said shaft, and means for removing such device from the shaft, without removing the shaft from its bearings.

524,387, TELEPHONE-SWITCH; Harry T. Johnson, Elizabeth, N. J. Application filed February 1, 1894. In a telephone apparatus, the combination of a circuit controlling device for making and breaking the circuit through the signalling apparatus, a local circuit, independent of the line circuit, for actuating said circuit controlling device, and a switch or circuit controller actuated by the movement of the telephone receiver to make and break the local circuit.

524,388. ELECTRIC SEARCH LIGHT; Edward R. Knowles, Middletown, Conn. Application filed January 9, 1893. In a search-light, the combination with the drum, of a diverging lens, and an electric motor supported on the drum, and moving therewith and arranged to operate the lens.

524,396. CONTROLLER FOR ELECTRIC MOTORS; William B. Potter, Lynn, Mass. Application filed December 21, 1893. The combination in an electric controller, of a switch having a multiplicity of contacts, and a blow-out magnet having a common pole piece extending from a common core to points adjacent to the several circuit-breaking points of the switch.

524,407. ELECTRIC MOTOR; William L. Silvey, Dayton, O. Application filed March 2, 1894. A field magnet for electric machines consisting of two wire-wound electro-magnetic rings, having pole pieces of alternate polarity projecting from their sides between the coils of the rings, the two rings united together by rods of the pole pieces of the two rings.

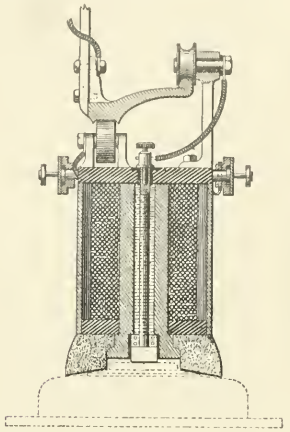
524,426. ELECTRO-MAGNETIC MOTOR; Nikola Tesla, New York, N. Y. Application filed October 20, 1888. The combination in an electro-magnetic motor with a rotary armature of field cores of different magnetic susceptibility and energizing coils thereon connected in series and adapted to be connected with a source of alternating currents.

524,462. ARC LAMP; Robert Drysdale, Everett, Mass. Application filed January 14, 1893. An arc lamp having a movable rack carrying a carbon, gear mechanism provided with a fan and engaging said rack, a movable frame in which said fan is mounted and an electro-magnet in circuit with the lamp for governing the position of said frame, a movable arm for engaging said fan, said arm being moved into engagement with said fan by means of a solenoid in circuit with the lamp and out of engagement with said fan by means of a spring-impelled lever.

524,467. INSULATING TURNBUCKLE; Henry Herbert Luscomb, Hartford, Conn. Application filed June 5, 1894. An insulator provided with a connection having applied to the free end thereof a bushing connection of non-oxidizable material fused to the metal of material of similar nature fitted to said bushing.

524,480. TELEPHONIC SYSTEM; Henry A. Chase, Boston, Mass. Application filed April 16, 1894. The combination with an electric circuit, of a telephonic transmitting apparatus provided with a mouthpiece and adapted to be included in said circuit, a circuit controller governing the said transmitter circuit, and a movable cover or shield, co-operating with the mouthpiece of the said transmitter and operatively connected to the said transmitter circuit controller, and provided with an arm having a hook to support the receiver.

524,524. TELEPHONE TRANSMITTER AND RESISTANCE VARYING MATERIAL THEREFOR; Frank R. Colvin, New York, N. Y. Application filed October 10, 1893. A resistance varying material for telephones, consisting of a mass of granules of carbonized petroleum residuum.

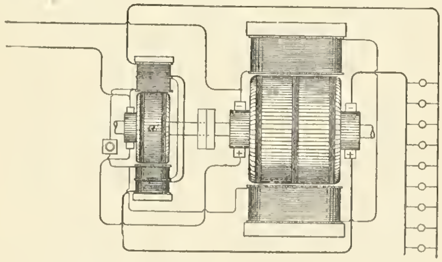


No. 524,367.—Electromagnetic Contact Making Device.

524,533. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR; Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y. Application filed May 10, 1894. A dynamo-electric machine or electric motor provided with a box-shaped field-magnet frame having interiorly projecting field-magnet cores, a removable cover on one side of the frame, lateral openings to permit the introduction and withdrawal of the armature, and standards for the armature bearings below said openings.

524,534. ALTERNATE-CURRENT MOTOR; William Stanley, Jr., Pittsfield, Mass. Application filed April 13, 1892. An alternating current motor, consisting of independent field-magnets or sets of poles adapted to be energized by alternating currents of different phase, in combination with an armature and coils thereon within the influence of each field, the coils in one field being connected with or closed through coils in the other field distorted or displaced with reference to the first.

24,541. PNEUMATIC CONTROLLER; Edward H. Dewson, Jr., Lynn, Mass. Application filed April 11, 1893. In a pneumatic controller, a cylinder, a piston therein geared to the switch or other device to be operated, a valve controlling the admission of air or other fluid under pressure to said cylinder, a stop adapted to control the movement of said switch, and a common lever which first operates said valve and then actuates said stop to control the movement of the switch.



No. 524,376.—Compounding Motor Generators.

524,542. PNEUMATIC CONTRO LER; Edward H. Dewson, Jr., Lynn, Mass. Application filed July 13, 1893. A pneumatic device comprising pressure cylinders and transmitting cylinders substantially as described, pistons, in said pressure cylinders respectively connected to pistons in said transmitting cylinders, non-elastic or incompressible fluid acting as the transmitting medium between said transmitting cylinders, and a cock for controlling the passage of said fluid from one of said transmitting cylinders to another.

524,548. AUTOMATIC ELECTRIC SIGNALING DEVICE; Edward Adolph Hermann, St. Louis, Mo. Application filed April 16, 1894. In a device of the class described, a supporting box, a rock-shaft, mounted in said box, a semaphore mounted on said rock-shaft, slides mounted upon said semaphore, and a rod connecting said slides to the said box at a point eccentric to the axis of said rock-shaft.

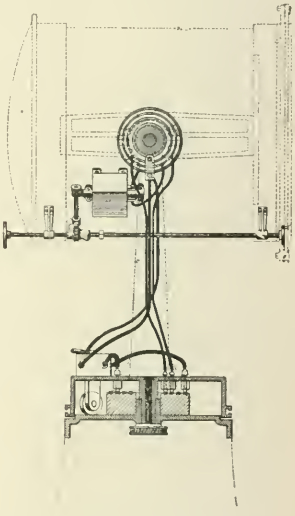
524,615. MOTOR-REGULATOR; Joseph F. Sheahan, New York, N. Y. Application filed May 28, 1894. In an apparatus of the kind described, the combination with the motor, the single rheostat arranged in the motor circuit, and the automatically operated weighted rheostat arm, of the pull knob operatively connected with the arm to raise it against the weight and thereby render it operative by hand as well as automatically.

524,625. TELEGRAPHIC TRANSMITTER; Frank F. Howe, Marietta, Ohio. Application filed January 15, 1894. A transmitter comprising a plurality of transmitting devices arranged with two or more of said devices in a series, an operating mechanism adapted to actuate each series at a different speed, and a circuit which is opened and closed by said devices.

524,630. AUTOMATIC CIRCUIT-BREAKER, Anatole C. Charles, Portland, Me. Application filed April 14, 1894. In a circuit-breaker for broken electric wires, a metallic bridge supported in a suitable case and insulated therefrom, a pivoted carrier mounted in said case, a circuit breaking rod having an inclined end set in said carrier and insulated therefrom, the inclined end of said carrier having a plate pivotally attached thereto and adapted to rest loosely upon said metallic bridge, but adapted to be disconnected therefrom by the breaking of the wire.

524,636. INDUCTION COIL; Charles L. Jaegerm, Maywood, N. J. Application filed January 18, 1894. The combination with an induction coil, having connection with two separate generators of electricity, of a device for automatically switching in the auxiliary generator on the failure of the primary generator.

524,646. ELECTRIC HEATER; Charles H. Newbury, St. Paul, Minn. Application filed April 18, 1894. A support for the incandescent filament of an electric heater, composed of two similar parts, each consisting of a bar having a cross-head, the edge of which is provided with half-round seats adapted to register with those in the similar part to form substantially circular openings for said filaments, and perforated supports adapted to receive and hold said parts in juxtaposition.



No. 524,388.—Search Light.

221,656. ELECTRICAL STORAGE BATTERY; Burton C. Van Emon, San Francisco, Cal. Application filed November 6, 1893. In an electric accumulator or storage battery, electrodes or plates protected on their sides and edges from the liquid solution of electrolyte by means of an elastic non-conducting and non-porous grid or form-separating frames or forms also of non-conducting non-porous material, having ribs or ledges that bear upon the walls of elastic material that contain and confine the active material so as to expose but one side of the latter to the electrolyte.

524,659. INSULATOR; George A. Winslow, Pittsburgh, Pa. Application filed December 8, 1893. An insulating body, an oil cup co-operating therewith and means for supporting said oil cup directly from said insulating body.

524,664. ELECTRIC BELT; Flora A. Brewster, Baltimore, Md. Application filed June 2, 1894. In an electric belt, a support containing an electric battery formed of two pieces of felt having secured to one side thereof a series of copper plates and to the other a series of zinc plates, the two series being electrically connected by metallic strips which pass through the pieces of felt.

524,672. TROLLEY-WIRE SWITCH; John M. Anderson, Boston, Mass. Application filed April 26, 1894. In a support for electric conductors the combination with side walls forming a grove, channel or way for the reception of the electric conductor, of a locking dog or cam supported in said grove between the said side walls, and a clamping bolt extended into a threaded socket in the side walls to operate.

524,684. INSULATING TURN-BUCKLE; Louis McCarthy, Boston, Mass. Application filed June 13, 1894. An insular comprising two shells having oppositely projecting connections placed within the same and insulating therefrom, a turn-buckle device having opposite ends of the same placed within the respective shells and insulated from each of the said connections by an interposed mass of insulating material.

The Electrical World.

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CONTENTS.

THE BUSINESS SITUATION.

Elsewhere we print a collection of views on the business situation, contributed by the leading members of the electrical industry, which is a most complete canvass of the field. The reader will find only encouragement in the opinions expressed, and doubtless will also be favorably impressed by the conservative tone everywhere noticeable, which offers such a strong contrast to the extravagant views bred of the speculative spirit of a few years ago. Taken in connection with the general revival of business throughout the country, the conclusion is abundantly justified that we are once more on the high road to prosperity, and that each succeeding month will add to the impetus, even now so strongly apparent. Still another expression of this general confidence is the volume of advertising in this issue, which reaches that of some of the special Convention issues in extent.

THE NEW TARIFF BILL.

We give elsewhere an account of the changes in the new tariff bill which have a bearing on the electrical industries. From this it will be seen that, aside possibly from the iron schedule and incandescent lamps, its influence on electrical business will be only an indirect one. Those most interested in the question hesitate to express an opinion at this early date as to any probable effect in the cases that may involve foreign competition, preferring to await the interpretation to be placed by the Treasury Department on doubtful points, and ascertain if a readjustment of domestic prices may not obviate foreign competition. The thirty per cent. reduction of duty on the kind of iron and steel plates used for armature discs may lead to more orders for these being placed abroad, for they have been imported even under the present rate of duty. This same remark might also apply to iron and steel castings and forgings for generators and motors. The reduction of the duty paid by the class of articles among which incandescent lamps have somewhat illogically been included, is very considerable—from 60 per cent. to 35 per cent.—and at present prices abroad would enable foreign manufacturers' agents to sell lamps in New York dangerously near American prices. Whether such lamps could compete in quality with our own is less open to question, the advantage lying with American lamps if we are to judge from the published results of tests.

REACTANCE.

One of our English contemporaries severely criticises Prof. S. P. Thompson for a misuse of the term "reactance," but in so doing itself falls into error. Prof. Thompson, in a paper read before the British Association, used "reactance" where "impedance" was the proper term, but until we read the criticism referred to we thought that there could be no doubt but that this error was merely due to carelessness or haste in writing, and are still inclined to retain that opinion. In the criticism, however, an error that cannot be thus excused is contained in the statement that "reactance is only that term in the impedence expression which is due to magnetic induction." The reactance of a circuit not only includes the effect of induction, but also of capacity, and has been defined as the reactive E. M. F. of self or mutual induction, capacity and other counter E. M. F. in the circuit, divided by the current, which is the meaning authoritatively accepted in America. The value of the term consists in differentiating the factors of the apparent resistance of a circuit that do not require the expenditure of energy to overcome them, from the ohmic or true resistance, which does involve the expenditure of energy. We may here remark that while, as our contemporary intimates, the origin of the term "re-

actance" is due to Heaviside, its practical introduction has resulted largely from the advocacy of Prof. Hospitalier—a fact which should have been more generally recognized than it has.

SIGNALLING THROUGH SPACE.

A paper with the above title was read by Mr. W. H. Preece before the Oxford meeting of the British Association, in which, as far as we can determine, there is little or no matter of importance, beyond a reference to resonance effects, that is not contained in a paper entitled "On the Transmission of Electric Signals Through Space," which was read by him before the Chicago International Electrical Congress and reprinted in the Electrical World of September 2, 1893. All of our readers are doubtless acquainted with the induction system of telegraphy to and from railway trains in motion. As far as we can see, the work of Mr. Preece has been merely to extend the distance over which this system can be operated, using, however, alternating currents of high frequency and employing the telephone for a receiver, which are most obvious changes. Both papers are clearly composite in their character, consisting of descriptions of empirical experiments and a scientific dressing apparently added with a view to giving the whole the appearance of a learned contribution, for it does not appear that the experiments were either guided by the many theoretical considerations brought forward or furnished any deductive grounds for their presence in the paper. In a recent experiment with two grounded parallel lines, each two miles long and four miles apart, it was found possible to transmit signals, but we cannot see that this proves, as stated, that similarly "we could readily communicate between England and France, or between outlying islands and the shore, when the conditions admit of the erection of the necessary circuits" though the qualifying clause renders the promise contained in the statement rather ambiguous and perhaps safe. Mr. Preece says that "a somewhat fascinating branch of this subject is the possibility of signalling across planetary space"; Mr. Maxim might similarly say that a fascinating branch of aeronautics is the possibility of traversing planetary space.

ENGINEERING EDUCATION.

The second annual meeting in Brooklyn last week of the Society for the Promotion of Engineering Education showed no abatement of the interest that marked the first meeting, held in Chicago last year. Besides the usual object of such bodies, which is to act as professional centers and to encourage the reading of papers, the present one also aims to arrive through its labors at a definite standard in engineering education and its methods. Owing to the chaotic condition of ideas—or perhaps it would be more correct to say, lack of ideas—in regard to such a standard, it will require a considerable interchange of views before the more important points will be differentiated, and the numerous papers thus far read should largely contribute to this end. It would seem desirable, however, to make some tentative declaration of principles in order to concentrate discussion, and while it may as yet be too soon to adopt this course, the best results cannot be achieved until it is done. First and most important is to decide as to what the education of the engineer should be, for until this is done there is little profit in writing of methods. What this education should be in turn depends upon the career the graduate is to follow, and the final solution will have to be in accordance with the requirements of this object. Much of the difference of opinion in regard to engineering education rests upon the different ideas held as to the subsequent career of the graduate. With some the main object is held to be the equipment of the mind of the student with principles, details being left to be learned during the apprenticeship which the graduate is naturally expected to undergo in the first years after leaving school. At the other extreme are those whose whole aim is to develop the wage-earning properties of the student, so that he can at once upon graduation enter into comparatively remunerative employment, the teaching of principles in this case being necessarily sacrificed to the teaching of details and manual dexterity. Between these are all gradations of views, and there does not seem to be any hope of any agreement as to the methods of education until some understanding is arrived at as to the ultimate object. The solution seems to be in a distinct division of engineering courses after the method followed in France. There we find three classes of schools which in most cases in this country are attempted to be combined in one curriculum. There we find separate schools for the education of the engineer who intends to practice the higher parts of the profession; also for those whose aim does not extend beyond the superintendency of a plant or other large establishment, and finally for those whose object is to become experts in the processes of an industry.

THE REVIVAL OF BUSINESS.

The long deferred passage of the tariff bill at last relieves the business interests of the country of an incubus which has been most depressing in its influence, and the numerous comments we print elsewhere as to the consequent effect in the electrical field are most encouraging. Of all the industries the electrical ones should find most hope under the new conditions, for now it will be possible to realize the many hundreds of projects which our news columns have noted during the last year, particularly in relation to electric railways, and to again resume the great march of progress recently brought to an almost complete halt. General Electric stock, which has recently been quoted as high as 46, is an illustration of the buoyant effect which began to manifest itself several weeks ago in anticipation of the passage of the tariff bill, the quotations previously having held around 36. That this effect has been pretty general in its extent is shown by the evidence we have gathered from many localities and many different branches of electrical and allied business interests. This is only natural, for it would be unreasonable to suppose that the previous great expansion of electrical business has received any permanent check by the depressing influences of the past year. At no period has its course, aside from promotion schemes, been an unhealthy one. Its prosperity has resulted from a natural demand springing from a recognition of the real economic advantages which its applications offer. With trade again in a normal state and these conditions unchanged, as they are, one need not be sanguine to expect a return to a state of prosperity which, though lacking the former flashy elements, will be none the less real. Some lessons have been taught that will have, it is hoped, a good effect in the future, and the experience of the past year will almost undoubtedly result in imparting a more business-like method to the conduct of electrical affairs. Owing partly to the rapid expansion of the industry and partly to a great influx of those unskilled in commercial affairs, much of the profit that otherwise might have been gained in former days was lost by unwise competition, and by too much reliance on the profits of the future and not enough attention to those of the present. The sore trial just ending has taught the stern necessity of looking out for details and not trusting to the future for too much aid in repairing the omissions of the present. The mischievous phrase about electricity in its infancy, which has been responsible for so much injury of this nature, is beginning to be discredited, and it would be well if it could also be left behind along with the other ills of the past year. If it should regain its old potency with returning prosperity, the result would be another stampede for the electrical field, more unhealthy promotion schemes and the derangement of the adjustments, so necessary for real commercial prosperity, that naturally result from the competition of novices, who themselves do not secure the profits which they divert from legitimate trade channels. With, therefore, the field cleared of much rubbish, better commercial ideas inculcated, and an industry based upon a healthy and expanding basis, there is every prospect of a near and prosperous revival of electrical business, and of a progressive extension that will be the more secure from lacking the abnormal elements of the past.

We give below a collection of opinions on the probable effects on the electrical industry of the passage of the tariff bill and on the general prospects for the future. The views expressed are those of representative men in every department of electrical business and from almost every section of the country, and form, therefore, an authoritative estimate of the situation.

E. I. GARFIELD, New England manager of the Ft. Wayne Electric Corporation, Boston: "Certainty is better than uncertainty. While the tariff bill is not satisfactory to the party in power, or to the country, it is far better than no action at all. Manufacturers now know where they are, for they have a certainty where before all was uncertainty. As a result, confidence will be restored and business will improve in all branches, but especially in industrials, and that includes electrics. Improvement will be slow, for it is impossible to recover from the effects of the panic in a month, or even a year."

Z. CHAFEE, president of the Builders' Iron Foundry, Providence, R. I.: "We consider that the effect will be beneficial. All lines of business will adjust themselves to the new conditions and prosperity will gradually return. The electrical industries will probably be among the first to feel the improvement."

ELBERT WHEELER, treasurer of the Wheeler Reflector Company, Boston: "We confidently expect a gradual and steady improvement over the conditions of the past year, and that legitimate enterprise will hereafter prosper. Our national prayer should now be: 'More business and less politics.' "

W. G. CHASE, treasurer of the Mason Regulator Company, Boston: "I do not look for any sudden revival of business. I think that this coming fall will show an increase over the business of last fall, but only in a moderate degree. It seems, from all indications, as if it would take a year at least for that class of manufacturers which we represent to resume their normal condition, and I do not share the views of many people who imagine that almost from the moment of the settlement of the tariff question, a sudden boom in all industries will take place."

E. C. HUXLEY, president of the American Tool & Machine Company, Boston: "Without entering into the merits or demerits of the tariff bill which has recently passed Congress, I have no objection to saying that the final disposition and settlement of the bill will doubtless tend to increase business as a whole, and, although I do not look for a great boom in trade, there will doubtless be a steady and healthful growth."

D. A. ANDREWS, JR., of the Pettingell-Andrews Co. Boston: "In my opinion any settlement of the tariff question by Congress will help the electrical business, as it willhelp all other branches, by giving a feeling of confidence that has been lacking since the present administration came into power. I do not think the special form of the bill is so important to our branch of the business as the return of business confidence."

N. MARSHAL, manager of the Iona Manufacturing Company, Boston: "We are pleased to state that there appears to be a slow, though unmistakeable improvement in our business, the volume for July, which is our dullest month, being very considerably over that of a year ago, and our August business so far has shown fully one-third above the same month last year, with less favors granted to buyers. While we do not look for a boom in our line of trade, we are making preparations to do a fair volume of business the coming fall, and shall be very much mistaken if there is not very considerable improvement from now on."

A. A. ZIEGLER, president and general manager of the Ziegler Electric Company, Boston: "We manufacture to quite an extent instruments and apparatus for educational and scientific purposes, and the highly cherished protection of American labor has not come to our assistance either under the old or the new tariff. A little more free raw material would, therefore, have been one of our wishes. Taken as a whole, we believe that the new law is an improvement on the old one and a step in the right direction, and that it will influence business favorably."

F. FOSDICK, president of the Fitchburg Steam Engine Company, Fitchburg, Mass.: "We believe that *any* settlement of the tariff question will be better for the present business than the unsettled condition which has prevailed, and that there will be a revival of business as soon as it is certain what is to be the final disposition of the mongrel tariff bill. It will inevitably, if it becomes a law, result in a reduction of wages in our view, as the classes of business not so directly affected by the changes in the tariff will be no less indirectly affected because of the necessary reduction in price of goods in other classes of business, occasioned by competition with cheap foreign labor. A reduction of wages means a reduction of the purchasing capacity, and therefore a reduction in demand upon the manufacturers. This, with increased importations, will doubtless affect all business, and we do not anticipate any such increase as would have been ours if the present tariff laws had been let alone."

H. N. FENNER, treasurer of the New England Butt Company, Providence, R. I.: "I agree with the many others who have expressed themselves on the subject, that notwithstanding the provisions of the bill the settlement of the question will bring renewed prosperity to us all."

W. E. SESSIONS, manager of the Sessions Foundry Company, Bristol, Conn.: "We think there is a little improvement in business generally and the prospect is for a gradual improvement, but not for any great change, in the next few months at least, unless the President should veto the tariff bill. We fully believe that if he should do so business would speedily improve."

C. E. BILLINGS, president and general manager of the Billings & Spencer Company, Hartford, Conn.: "While we are not wholly satisfied with the result of the tariff question, we believe now that it is settled that business will generally improve, not only in the electrical field, but in all other lines."

R. F. BLODGETT, secretary of the Pratt & Whitney Company, Hartford, Conn.: "As we are not properly in the electrical trade, we have some doubt about the propriety of expressing our opinions upon the electrical industry during the ensuing fall and winter. We do not wish to assume any gifts of prophecy, and would prefer not to say what we think may be the course of business in our line. We anticipate little improvement for several months, but feel confident that we will do more business from September 1 to December 31, 1894, than we did in the same months in 1893. Our order books for several months have looked well."

T. C. PERKINS, vice-president of The Mather Electric Company, New York and Manchester, Conn.: "As to the prospect of the general improvement in business, we are glad to state that recently and since the practical settlement of the tariff matter at Washington, we have experienced a very marked and healthy improvement in our business. Our business has even increased much more rapidly than we anticipated, and we look for a continued improvement hereafter."

W. C. BRYANT, treasurer and manager of the Bryant Electric Company, Bridgeport, Conn.: "It is a little early as yet to predict, but it seems to me that as most of the dealers and consumers have carried very little or practically no stock for the last year, as trade increases the manufacturers are certain to be very busy. If the tariff uncertainty is settled within another week, as it now looks as if it would be, I think we may reasonably expect a prosperous fall for the electrical trade in general, debarring the one fact that prices are low and we have got to do a larger volume of business to get a fair profit."

H. L. LUFKIN, manager of the Crocker-Wheeler Electric Company, New York: "The outlook for business, particularly of electrical power transmission in the mills and factories, is especially promising. The one unfortunate feature, however, is

the fact that in the severe struggle to secure business during the present period of depression, prices have been so slaughtered as to leave little or no margin of manufacturing profit. Conditions of this kind are too apt to lead to the production by the manufacturer of inferior apparatus, or of the sale of apparatus which is more or less overrated in capacity, as the case may be. It is perhaps unfortunate that dynamos and motors have no commercial rating by which their capacity can be readily and accurately determined by the prospective purchaser, as is the case with a steam engine. Had we a rating of this character. I am inclined to think that there would not be the vast differences which are now sometimes found in a set of bids, apparently made on similar specifications, and it would help in a degree to straighten out the matter of prices on apparatus, and be in general of great value to the trade.''

E. W. Little, vice-president and general manager of the Interior Conduit and Insulation Company, New York: ''We manufacture electrical specialties, the patents of which are controlled by our company both here and abroad, so that we have not felt the prevailing dullness from the tariff squabble as much as the other lines of trade. Of course, we are glad the question is settled as we think people will now buy more than they have been. Though our trade so far for 1894 does not show as great a percentage of increase as it has the last two or three years, business is fairly good, with the prospect of it being much better.''

T. J. Smith, manager of The E. S. Greeley & Company, New York: ''Our South American trade has been the steadiest and most remunerative part of our business during these dull times. The local trade has been provokingly stagnant for over a year, though we think even so that our sales have been twenty-five per cent. above other supply houses. Though the present tariff will not affect us directly, I do not look for prosperous times until trade and wages are regulated to the conditions of the tariff schedule. In the end there may be a benefit, but I hardly think the electrical supply trade will reach the proportions it did two years ago.''

J. E. Ham, general agent of W. R. Brixey, New York: ''Our factory has been running full time so far this year, though our orders have been curtailed somewhat on account of the tariff dilatoriness. Now that it is over with we hope for better times.''

J. J. Gorman, of the Manhattan Electric Supply Company, New York: ''It is too soon for the passage of the tariff bill to have any material effect on our business, but we do look now to better times with the revival of trade which is sure to come. As far as tariff duties are concerned, they do not bother us particularly. We have had the best months during May, June and July this year than we have had since our business was started, and it looks now as if the volume of trade for August will be up to the standard of those prosperous months. It is still pretty hard work to make collections, but these are far easier than they were a year ago.''

W. P. Jones, secretary of the Law Battery Company, New York: ''Irrespective of what is embodied in the Congressional bill before the President for approval, we believe that, if it secures his signature, or is permitted to become a law *per se*, the state of uncertainty that has pervaded the business world in general for a long time past will immediately give way to a feeling of confidence to the extent at least of inducing the circulation of much of the money that has been kept in a state of innocuous desuetude awaiting some definite action by our legislators. Now, if—and the if here is a very important factor—we incline toward the sentiments of a large number of our friends, this assures commercial activity to the business world in general during the fall and winter; on the other hand, if we voice these sentiments of many others, this will hold good only with a select few. Being thus situated between two fires, we are inclined to believe that the time is not yet ripe enough to give a satisfactory answer to your first question. Turning to our own field, we should say, taking our own experience for a basis, that a revival of trade has already commenced; and that if the handlers and consumers of electrical goods who have a propensity to look at cheapness rather than quality will only see the error of their ways, reverse their views and thereby permit contentment to enter the homes of the working men, the manufacturers will then be enabled to live up to the motto, 'A true workman is worthy of his hire,' the revival will be permanent—permanent, at least, for a long time ahead. The law of supply and demand is a factor that cannot, of course, be ignored, but in a country like ours the vintage is large and the harvest consequently in proportion.''

Chas. D. Shain, New York: ''The slight change in the tariff schedule will not, in my opinion, practically affect the electrical business in any way. The passing of the new tariff bill and the settling of the question which has been hanging fire so long, will, no doubt, give business generally an impetus and the electrical trades will of course benefit thereby. In the past years there has been so much illegitimate financeering in the electrical business, causing an unwarranted growth, that it will, in my opinion, take some time to get back to conditions existing before the panic. Undoubtedly the electrical business has a great future before it, but it must and will become a legitimate business and the quicker it does so the better it will be for every one concerned in the trade. I am inclined to believe the hard times have been a benefit in disguise to our industry and look forward to the future as one of solid growth.''

Frank M. Pierce, president of the Pierce & Miller Engineering Company, New York: ''It is our opinion that there will be a marked, though temporary, improvement in business, due to the passage of the tariff bill, not because the bill in itself is not antagonistic to general business interests, but because a settlement of the question, one way or the other, enables business men to discount the future with some degree of certainty, and arrange their business accordingly.''

Thos. C. Wood, president of the Ball & Wood Company, New York. ''All through this depression there has run an undercurrent of demand and supply sufficient to keep alive most of our industries not directly affected by tariff legislation. In our own line of manufacture not only has our entire force been employed, except during a few months late in 1893 and early in the present year, but since May 1st our night gang has been regularly at work. The time has gone by when a manufacturer can build engines for stock, especially for the electrical industry; each order has its own special features, specified by the consulting engineer in the case, and as all of these require changes in patterns and design and take time to accomplish, the delivery of orders is spread over a longer period and changes in the general business conditions are less abruptly felt. It has been astonishing all through the panic to find, on looking over the files of your paper, the number of new railroads and new lighting plants projected, or plans contemplated for extensions and betterments in old ones. If there has not been sufficient to keep us all at work, it has had the effect at any rate of causing those who were dull to see the necessity of broadening their markets and of making an effort to obtain a share of foreign trade which Americans have always been too slow to prosecute. As to the passage of the tariff bill and the effect it will have on business, it cannot fail to be good, and the further adjournment of Congress will remove the uneasiness the business world always feels when it is in session. It seems likely that further tariff tinkering will be done piecemeal, regardless of what party is in power, and that politicians will be wary about again taking up any wholesale revision for a long time in the face of our recent experience. Our money seems to be fixed as honest, and in the field of labor the air too has cleared. With all of these facts in view the course of business must be upward, and if slowly upward then all the better. I look, therefore, for gradual improvement in business, though it will be many months, I fear, before prices regain their lost ground or labor will be as highly paid as in the past.''

Jas. L. Robertson, Jr., president and general manager of the Hine & Robertson Company, New York: ''We look for a gradual improvement in business from now on, unless our imports should reach such a figure that our good resources will be taxed to an extent to create alarm and uncertainty among moneyed men and institutions to whom we must look for assistance in building up our crippled industries. We certainly hope such will not be the case.''

Geo. L. Colgate, president of the Geo. L. Colgate Company, New York: ''Having recently completed an extended trip West and South, I am able to speak regarding business prospects from more than local experience. There is not a shadow of doubt as to the immediate awakening of business activity and of a conservative continuance of good business. Very shortly 'depression' will be past history, and we will feel the vibration of the movement of business that has been bottled up, as it were, by ultra-conservatism and tariff tinkering.''

J. H. Vail, president and engineer of the Electrical and Mechanical Engineering and Trading Company, New York: ''It should not be overlooked that the effect of the new tariff bill upon many departments of industry is purely guess work and that experience only will determine the benefits or disadvantages accruing. We do not anticipate any immediate 'boom' but rather a gradual recovery from conditions of extraordinary depression. Electrical industries have had a more severe set-back during the period of financial depression than almost any other line of business. We believe that

the reasons for this are that many 'wild-cat' electrical enterprises have been invested in by a confiding public without a proper knowledge on the part of the investor, or a conscientious regard as to their real value as dividend earners on the part of the promoters. The proof of this is abundantly shown in the annual reports of electrical companies, in one of which we find several millions of dollars worth of securities written off at a nominal value. The commercial electrical business must be brought down to, and maintained upon, a legitimate basis; that is to say, the capitalization and actual investment should be limited to the real necessities of the case. Let the promoters of such enterprises be satisfied with actual profits earned by an operating concern in preference to swelling the enterprise at the outset with a large amount of watered stock of fictitious value."

J. H. Seymour, president of the Clark Electric Company, New York: "The various causes which have brought the severe conditions of business in general are passing away, but it will take a little time to restore the conditions of four years ago. We must date the beginning of the business troubles from the financial embarrassment of the great banking house of Baring Brothers, in 1890, which caused a severe shock to financial confidence the world over, and especially to this country. The beginning of loss of confidence has been intensified by political legislation by Congress, and, in addition, by the unsound business methods in every branch of industry brought on by over-trading and speculation schemes. In regard to the electrical industry for the future, it seems to me that it never had a better prospect. The volume of our business may not be as great as we would like it this fall and winter, but it will increase rapidly in a short time, for the reason that the American people have great confidence in the possibilities of electricity."

W. J. Clark, general manager of the railway department of the General Electric Company, New York: "Within the last few months our business has shown a remarkable improvement, and now that this tariff muddle is settled, I believe we will soon do as large, if not a larger, business than we have ever done since the organization of the General Electric Company. During a recent extended trip throughout the West and South, I was greatly impressed with the determination of the people there to throw off the prevailing depression and to get to work on a profitable basis again. The South and West have been the most discouraging fields for all kinds of electrical construction for over a year. The work there has been so light that it might be counted as nothing. There is now every indication that electrical buying from these sections of the country will, before long, be what it was two years ago. One of the most cheerful signs of the revival of trade is the increasing number of small orders we are receiving for our apparatus. While we look upon big orders as a sheet anchor, and, of course, necessary to our existence, the real barometer of business conditions is the number of minor contracts from all sections of the country. Heavy capitalized concerns purchase large quantities of supplies when prices are low, no matter whether the goods are absolutely needed or not. But small firms cannot do this. For over a year these small companies have been buying from hand to mouth, and patching wherever possible. Now they are coming to the front with orders and that shows that the people are getting over their scare, and are alive to the fact that money can still be made in this country. I see no reason why electrical industries should not have a tolerably active and profitable winter."

R. B. Corey, manager of the Electric Construction and Supply Company, New York: "It is plain that the electrical industry will be benefited by the settling of the tariff question. The electrical business, like other lines of trade, is dependent largely for prosperous times upon the general condition of affairs. Now if people build more and buy more, it, of course, quickens the pulse of the electrical industries, and there is every indication that the public are getting over their timidity to enter trade, and will now come out in force. Already we see an improvement in orders since the passage of the bill, and even if people are acting mainly from sentiment it is a change for the better. It now seems to me that we will have a steadily increasing fall and winter trade, and a very profitable business next spring. If crops are good next year we ought to have a veritable boom in electrical industries in the fall of 1895. These hard times have taught American manufacturers one good lesson. They have learned how to manufacture at a less cost during the last year and a half than they have been doing during the preceding ten years. The dullness has forced them to make labor saving improvements and reduce unnecessary executive expenses, so that manufacturing is now down to a thoroughly economical basis. We can easily compete with any nation in the production of electrical apparatus, and I have no fears from any low tariff schedule. The tariff that brings the greatest prosperity to the greatest number is the one for the electrical business."

G. N. McKibbin, of Reed & McKibbin, New York: "The tariff question has not bothered us much, as electric railways are something it cannot directly affect. Naturally we are glad the uncertainty is ended, as people will now show more courage and forget past troubles. An era of trade and commerce will make a demand for more electric railways, and we look to busy times in this class of work during the next two years. We can say that so far as we are concerned, the past year has been a good one in electric railway construction. The season is about over with now, though we are still negotiating on the building of several fair-sized roads. As our work is confined strictly to the Eastern section of the country, it accounts for our doing so well, as Western electric railway building has been practically dead during the past year."

H. B. Cheever, manager of the Okonite Company, New York: "Our trade this year has been similar to that of 1893. While as yet there has been no extension in our trade, business is fairly good. Last year we had some bother in obtaining money for our pay-roll, while this year money is plentiful. We have never known such low money rates since the establishment of the Okonite Company. Bankers really ask us for our paper. While the present tariff will undoubtedly ultimately benefit trade, I do not look to great improvement for a year or more."

R. L. Shainwald, president of the Standard Paint Company, New York: "We expect the present tariff will be a benefit to all industrial circles. People want to get to work, and now that the vexed question is settled, every one will pitch in and try to retrieve some of the losses they have suffered for the last two years. We anticipate a moderately good winter trade, with old-fashioned prosperity later on."

Jas. P. McQuaide, secretary and treasurer of the National Conduit Manufacturing Company, New York: "I have just returned from an extended trip through the West, and I must say that I have never known of so much business in our line contemplated for the immediate future. There seems to be, though, rather a feeling of uncertainty and the work is delayed until the last hour on that account.

P. H. Kobbe, treasurer of the Westinghouse Electric & Manufacturing Company, New York: "So far as we are concerned we have not bothered our heads any about tariff bills, as our factory has been crowded to its full capacity, so as to fill all of the orders for the present year. If the rest of the business community is benfited by the present tariff bill, we expect to get our share of the increasing trade. It is a little early yet for manufacturers of heavy electric machinery to feel any better state of affairs from the tariff change, so that we cannot say that we have received a larger proportion of orders since the passage of the bill. But when the rushing business does come we expect to be ready for it in the completion of our new works at Brinton."

J. W. Godfrey, general manager of the New York Insulated Wire Co., New York: "Owing to our line of goods we have not suffered much from the tariff wrangle and our business is in good shape. Money is easier, collections are fair and by our exercising greater caution we have a better class of customers than we had a year ago. Prices are down to ridiculously low figures. I think American manufacturers have cut them down lower than was necessary, for at present rates it is almost impossible to realize any profit. With the tariff nightmare out of sight the downward tendency of prices may be checked, but I do not look for any appreciation for a long period. Our present volume of business nearly equals the high water mark of 1892, and the outlook is favorable for increasing trade. There is no doubt to my mind that the electrical industries are to-day on a firmer, more substantial basis than they have ever been before, the business is past being a novelty with novel prices. A few years ago manufacturers could get fancy figures for their productions, as the goods were new and people were willing to pay high rates for the then limited supply. Now electrical apparatus and appliances have become staple wares, and the industry has gained the stability which comes with the trading in an indispensable standard line of goods."

W. F. D. Crane, of the H. W. Johns Mfg. Co., New York: "If the tariff bill is beneficial, and in all probability it is, I think our trade will soon increase to the amount it was in the best days of two years ago. We have had a first rate year so far and have held our own, considering the prevailing dullness, far beyond our

expectations. There is a better tone in the market since the new tariff bill has become a law, and people whose business was in a broken down shape now report that they are confident that they can pull through and soon do business on a paying basis. There is every reason to believe that the electrical trade has now been given an impetus which will end in general prosperity."

A. Mitchell Hall, general manager of The C. & C. Electric Company, New York: "There is every possible indication of a marked revival in business, especially in that portion of the electrical field to which we have devoted our partcular attention, that is, electrical lighting and the electrical transmission of power. Not only are orders being placed, but our mail is full of inquiries, which is also a pretty sure indication of business to follow. Altogether, we think the prospects for business this fall decidedly bright."

George E. Long, Secretary of the Joseph Dixon Crucible Company, Jersey City, N. J.: "We, like all manufacturers, have experienced our share of the general depression in business, but we are now experiencing, as we know many other manufacturers are, the upward rise, and are having quite a decided improvement in all our various departments."

H. Ward Leonard, president of the Carpenter Enamel Rheostat Company, Hoboken, N. J.: "Our business has been so recently established that we can hardly make comparisons between our present business and that of past years, but in our particular line the present conditions and prospects for the future are very satisfactory, as we have been obliged to work over time for several months past and are likely to be obliged to do so for some time to come."

R. B. Cissel, secretary of the Backus Water Motor Company, Newark, N. J.: "Our experience for the past season in the goods which we manufacture in the electrical line has shown a great improvement over the business of former years, and a large increase of sales. We believe that the prospects for the improvement of business at the present time are good."

H. J. Gorke, manager of The Electrical Engineering & Supply Company, Syracuse, N. Y.: "We have found business very lively all the way along in some of our lines, and have been unable to find a week when we could conveniently shut down our entire factory for a general vacation. The only thing we have to deplore at present is the competition that has been working disaster in prices on general lines of incandescent appliances. The outlook for a prosperous fall trade is encouraging to us."

S. F. Bagg, secretary Watertown Steam Engine Company, Watertown N. Y.: "We should say that the electrical industry being less affected by tariff conditions, except, of course, as it is in sympathy with other industries, had suffered less from the present depression than almost any other line of business and therefore is less likely to show any very sudden and pronounced reaction. At the same time, so far as our observation goes, business in this line seems to show a marked improvement already. The easy money market and the expectation of an early resumption of business have combined to put fresh life into the many projects that have been held in abeyance for the last year. Besides this we notice a larger number of new enterprises starting than for many months previous. Our mails show a somewhat. large number of promising inquiries, but it is still more noticeable that a much larger percentage of inquiries materialize into orders. During the whole of last year we were called on to make estimates and prices almost as often as in the most promising times but the matter generally ended there. In the last month or two we have found that a much larger proportion of these inquiries developed into orders, either to us or to some one else. While the indications for the future do not seem to promise anything in the way of a boom, nevertheless, it seems to us that we have good reason to expect an increasing and permanent and healthy business during the fall and winter."

The Delaware Hard Fibre Company, Wilmington, Del.: "That part of our business which is in the electrical line shows very decided indications of an improvement. For the past three months our sales have been about forty per cent. more than during the same period a year ago and the indications are that this proportion will hold through the fall and probably increase."

Pepper & Register, electrical and mechanical engineers, Philadelphia: "Within the last few weeks we have had a great many new inquiries and we see clearly ahead a great deal of good business, enough we hope, to give all contractors a fair share and to raise prices to a profitable standard."

Carlton M. Williams, secretary and treasurer of Morse, Williams & Company, Philadelphia: "The wisdom of the Philadelphia lawyer is proverbial, but we must confess that it is beyond the power of an ordinary manufacturer to make any accurate prediction as to what the prospect is for an improvement in business during the ensuing fall and winter. We find that some people are ready to take advantage of the extremely low prices prevailing at present to make improvements so that they will be ready to handle business when trade does revive; this no doubt is a wise course to pursue, as there is not near enough trade to satisfy all, the competition being so great that prices are extremely unsatisfactory. Stocks of goods in all lines are so low that when trade does revive, purchasers will no doubt require early delivery."

Charles M. Wilkins, of the Partrick & Carter Company, Philadelphia: "That there is room for improvement is the opinion of business men everywhere. The present state of affairs has not been brought about suddenly, and while the recent action of Congress will undoubtedly have the effect of restoring confidence in business circles, it will be some time before financial, manufacturing and commercial interests can adapt themselves to the changed conditions brought about by the adoption of new tariff regulations. There is another important issue which neither of the dominant parties seem disposed to handle properly, namely: 'The solid money question.' The financial policy of this country must be placed on such a basis as will leave no room for doubt as to its soundness. This is as important as the tariff. I am of the opinion that there will not be any great change for the better during the present year, but I confidently believe that 1895 will be a good year for the business world. Dealers have allowed their stocks to run down to the very lowest notch, and have only made necessary purchases, and when the revival comes supplies of all kinds must be bought, new enterprises will be started, and, to use a slang expression, 'those who stay in the game will come out ahead.'"

J. H. McEwen, president of the J. H. McEwen Manufacturing Company, Ridgeway, Penn.: "Our business has been very good this summer. We are working full capacity with plenty of orders ahead, but as to the future, we believe that the improvement in business will be very gradual."

Maurice W. Thomas, secretary and treasurer of The Mason Telephone Company, Richmond, Va.: "The outlook for business in this section is good. There has been no very great change in the situation since the passage of the tariff bill, but I note a general brightening all along the line. In our own particular branch, that of, the construction of telephone plants throughout the country, I am glad to be able to report brisk business, which I feel is but the forerunner of a large trade in the fall."

Chas. F. Thompson, secretary and treasurer of the Lane & Bodley Company, Cincinnati, O.: "The earlier months of the year 1894 found the electrical demand the only one for steam engines. During midsummer sugar and cotton oil interests called upon manufacturers and there is at present a hopeful prospect for the wheat milling interest this fall as an absorbent of the engine supply. Owners of electric lighting plants will lose a golden opportunity if their contracts are not placed this year for new power of the most economical operation, and since it is unreasonable to suppose the active-minded managers of this industry are not alert to their opportunity, we believe the demand for engines for electric industry will steadily increase from this time."

S. M. Hamill, general manager of the Brush Electric Company, Cleveland, Ohio: "The manufacturing and selling of electric lighting apparatus during the past has not been conducted on as conservative a basis as it might have been. The financial and other troubles of the last year have led to a change for the better in this particular. The improvement in business, which will undoubtedly come, will in our opinion not be as rapid as some imagine, but it will be permanent and a greater business will be done than ever before. The manufacturers and local companies have been taught a severe lesson, but will profit greatly thereby."

R. N. King, president of the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio: "Our business with electrical companies is largely with the better class, where first-class machinery is wanted and where in most cases the development depends upon a sale of securities, and the only thing particularly needed now is a good bond market. Our idea is that good water power electrical development bonds, when better known in the market, will be a favorite form of investment, for the reason that the revenue from the sale of electrical power is likely to be a steady and permanent income and not affected by the changes and fluctuation of the markets. The outlook is particularly good for business in our line."

C. K. King, manager of the electrical department of the Ohio Brass Company, Mansfield, Ohio: "In regard to the probable

improvement in the fall and winter trade in electrical supplies, if the new tariff bill will affect the money market so as to enable the promoters of street railway enterprises to sell their bonds there undoubtedly will be many new roads built.''

GEORGE CUTTER, Chicago: "I interpret the indications to be very favorable for a steady and a marked improvement in electrical business within the next few months. The increase in demand for money in this city since the passage of the tariff bill indicates a revival of confidence, and if nothing happens to check this the result will probably be a very great help to electrical enterprises. I find that during the business depression many promising and valuable schemes have been worked up, which are only waiting for the money to carry them through. The favorable impression among business men will surely develop that confidence which is needed to induce capitalists to invest, and this is really all we need to make our business thrifty."

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago: "The prospects of a busy fall seem very bright here in all lines, and especially in telephone matters; in fact, at present we have nothing to complain of. This company has contracts for a great many exchanges, and has several under way."

CHAS. E. GREGORY, president of the Chas. E. Gregory Company, Chicago: "We beg to advance the opinion that the general business of the country will experience marked improvement in the fall, particularly the electrical industries. Our inquiries from all over the country lead us to this conclusion, and we have prepared for twenty-five per cent. more business than we did in the fall of 1893. We do not know what hard times are, except by hearsay."

THOS. I. STACEY, secretary and treasurer of the Electric Appliance Company, Chicago: "The electrical supply business, in particular, has felt a marked and steady recovery, dating from about January first. This has been interrupted somewhat by July and August business which is usually very light, and this summer is no exception. This gradual recovery of business will undoubtedly be resumed in September, continuing through the coming winter and spring. I do not, however, anticipate a sudden recovery or a very large volume of business during the coming season, but believe that the fall and winter of 1895 will find the business in a fairly normal condition, provided no further setbacks are encountered."

B. E. SUNNY, manager of the General Electric Company, Chicago: "There is a decided improvement, the evidences of which have been many in the last two weeks. It is curious to note that we have had the same number of orders during August that we had a year ago, and the year before that; but the orders recently have been for practically double the quantity required for many months past, showing that station managers have been economizing. I expect that the autumn will be a season of unusual activity in all branches of electrical work and that there will be a gradual and steady improvement from this time forward."

J. B. WALLACE, manager of the Wallace Electric Company, Chicago: "We regard the prospects for an improvement in business as decidedly good; in fact, this improvement has already commenced. There is a notable increase in the volume of business and the amount of inquiry is still more marked, showing that people are considering seriously the question of repairs, reconstauction or increase of their facilities. For more than a year the most rigid economy has been the general rule in Western electric lighting plants, and in many cases they have given orders not to buy anything that could possibly be avoided or done without. In consequence of this the average plant is not in a physical condition to go through another lighting season without making very considerable purchases for repairs and reconstruction, and in addition I look for considerable business in the way of increased facilities, many of which were planned a year ago, but put off on account of the uncertainty."

J. E. KEELYN, president of the Western Telephone Construction Company, Chicago: "The promised improvement in the business situation is shown in the last week's correspondence. Our orders in the last week have run into telegrams of an imperative nature, where in the past letters have been considered quick enough. We all feel that there will be a decided improvement from now on. Money is at a low rate of interest. Real estate enterprises are exceedingly dull and unprofitable, and other lines of effort, particularly manufacturing, will have no trouble in obtaining money on favorable terms, in fact on better terms than in the past. One great trouble with the electrical, as well as other securities, is that they have been too much 'watered,' and capital has lost confidence to a certain extent; but this, I am certain, will be regained now that the hard times have taught many lessons. In the telephone line an extraordinary prospect for sound and profitable investment presents itself, and wherever an enterprise of this character is conducted on legitimate basis, there is no reason why it should not prove a handsome investment. On the whole, therefore, I can safely predict that the country will now enjoy a season of substantial prosperity, better than for a few years past."

F. E. DRAKE, of Standard Electric Company, Chicago: "From our standpoint the outlook is more favorable than it has been for many months. All of our departments are running full time and full handed. At the same time the best I look for during the coming winter is business enough, at a fair margin of profit, to give us a living. It will be spring before there is any grand revival. But the change up to the present time is very encouraging."

W. C. MCKINLOCK, secretary of the Metropolitan Electric Company, Chicago: "Business has already taken a decided start and we look for a splendid business this fall. Apparently lighting stations and railways have been waiting for a long time before ordering and now they have taken matters in hand with vigor."

W. W. LOW, president of the Electric Appliance Company, Chicago: "The situation is splendid and the outlook is equally good. It may seem talking 'shop,' but our own business may be taken as an evidence of the general condition. We expect that the improvement will be gradual and steady, and that by spring we may experience something of a boom."

A. WEINBERG, Union Brass Manufacturing Company, Chicago: "Business is gradually and steadily picking up. The evidence of prosperity already at hand leaves no doubt in my mind that the fall will be one of very noticeable activity and the winter should bring us a good business at reasonable profits."

J. H. RHOTEHAMEL, president of the Columbia Incandescent Lamp Company, St. Louis, Mo.: "We have noted a decided improvement in our business during the past few weeks. The improvement does not seem to be confined to any particular part of the country, but is general, coming from all sections. We look forward to a larger business this fall and winter than at any time heretofore since the organization of our companya, nd think that the improvement already noticed confirms our views. We believe that recent improvements in high economy incandescent lamps will very materially increase the electric lighting business, as it will bring the price of electric lighting nearer to that of gas and the use of incandescent lamps will be largely stimulated thereby."

The New Tariff Schedules and Electrical Manufactures.

Owing to the general criticism of newspapers in regard to the loose manner in which the new tariff bill has been drawn up, those whom its provisions may affect are chary of expressing an opinion, particularly in regard to items whose classification may be subject to new rulings. It does not appear, however, that the electrical industries will be notably affected, though in one or two instances, hereafter referred to, it is possible that foreign competition may result.

While unmanufactured copper is placed on the free list, this will introduce no change, as the principal foreign supply is imported from the United States. Bare and insulated copper wires will also be unaffected, though the duty on the former is reduced from 45 per cent. to 35 per cent., and on the latter from 35 per cent. to 30 per cent., vulcanized rubber and indurated fiber also coming under the latter figures. A large cut is made in bar zinc—to 1 cent from $1\frac{3}{4}$ cents per pound; unpolished sheet zinc is reduced from $1\frac{1}{4}$ cents to 1 cent per pound, and scrap zinc from 45 per cent. to 35 per cent.

The duty on electrical machinery is reduced from 45 per cent. to 35 per cent. Arc lamps come under this classification, but the duty on arc light carbons remains unchanged at 20 per cent. The former duty of 60 per cent. on electric shades becomes 40 per cent., and that on porcelain is reduced from 55 per cent. to 30 per cent. Notwithstanding these large reductions, we are informed that they will have little effect in increasing importations, though on some goods somewhat lower prices may result, both on imported wares and on domestic wares at present competing with imported articles.

Notable reductions are made in duties on iron, of which the most important affecting the electrical interests are those relating to thin sheets of iron or steel, such as are used for armature discs, as under the former rates this material was sometimes imported. The duty on sheets between Nos. 10 and 20 gauge is reduced from 1 cent per pound to .7 cent; between Nos. 20 and 25, from 1.1 cents to .8

cent; and above No. 25, from 1.4 to 1.1 cents. Forgings of iron and steel are reduced from 2.3 to 1.5 cents per pound (provided this be not below 35 per cent. ad valorem), and iron castings from 1.2 cents to .8 cents per pound. Steel castings valued between 4 and 7 cents per pound, are reduced from 2 to 1.3 cents per pound; valued between 3 and 4 cents, from 1.6 to 1.2 cents; between 2.2 and 3 cents, from 1.2 to .9 cent. between 1.8 and 2.2 cents, from .9 to .7 cent.

Heretofore incandescent lamps have come under the classification of "Manufactures of glass not otherwise provided for," on which the duty has been reduced to 35 per cent. from 60 per cent. Should this classification be adhered to, foreign lamps may be able to compete with those of domestic manufacture at present prices, as they can now be delivered in New York at 25 cents per lamp, duty and freight paid.

Tesla Effects with Simple Apparatus.

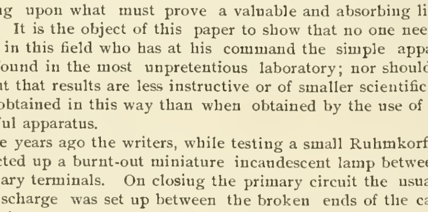
BY H. M. MARTIN AND W. H. PALMER, JR.

All who visited the room in the Electricity Building at the World's Fair in which Mr. Tesla's high frequency apparatus was exhibited must have brought away with them a lively desire to repeat at their leisure the beautiful and interesting experiments there shown; but a recollection of the many expensive appliances used in obtaining the effects has doubtless deterred many from entering upon what must prove a valuable and absorbing line of study. It is the object of this paper to show that no one need fear failure in this field who has at his command the simple apparatus to be found in the most unpretentious laboratory; nor should it be thought that results are less instructive or of smaller scientific value when obtained in this way than when obtained by the use of more powerful apparatus.

Some years ago the writers, while testing a small Ruhmkorff coil, connected up a burnt-out miniature incandescent lamp between the secondary terminals. On closing the primary circuit the usual violent discharge was set up between the broken ends of the carbon. While the current was on one of the connections became unfastened, leaving the lamp joined to only one of the coil terminals, as in Fig. 1; and the discharge instead of being extinguished, changed to a soft glow that filled the whole interior of the lamp. This was, on a small scale, identical with the experiment performed so brilliantly by Mr. Tesla during his London lecture, when he lighted an exhausted bulb, having a sealed-in electrode, through a single lead from a source of high potential and frequency.

Although this experiment was often repeated, its significance was not realized until Mr. Tesla made known the results of the researches which have entitled him to rank among the foremost investigators of our times. But the published report of the lecture placed the previous experiment in its true light, and inspired a hope that other effects might be duplicated with the feeble apparatus at hand. The results have more than fulfilled our expectations.

The necessary potential and frequency were obtained from a small



FIGS. 1 AND 2.

Ruhmkorff coil capable of giving a quarter-inch spark when operated by three Bunsen cells.

Two insulated metallic plates 12"x12" in size were placed about three inches apart and connected with the terminals N and P (see Fig. 2). Exhausted bulbs, miniature incandescent lamps, Geissler tubes, etc., were then introduced between the plates, and glowed brightly without any direct connection with the plates or coil. Actual photometric measurements of the maximum light emitted by this arrangement show it to be greater than that obtainable by using the current directly in an incandescent lamp. This is significant as showing the poor economy of the present methods of electric lighting, and leads us to believe that molecular bombardment electrostatically sustained contains great possibilities in this connection.

A slight modification of this arrangement makes it possible to dispense with one of the two plates. In all these experiments the battery cells act as a species of reservoir or condenser, so that tubes and bulbs lying in their vicinity are often seen to glow brightly and fade, in proportion as the capacity of the apparatus is changed.

Incandescent lamps may be lighted through a single lead from one of the secondary terminals; this effect is greatly heightened if the hand or some other object of capacity is placed near the lamp bulb. The small 6 c. p. lamps are peculiarly adapted for use in these experiments, their shape seeming to concentrate the molecular bombardment upon the carbon filament.

If a good mercurial air-pump is not accessible, vacuum tubes that will serve for want of better may be obtained by heating mercury in a piece of tubing, and sealing the end after the mercury has reached the boiling point. A pretty experiment may be performed by holding the exhausted tube in one hand, with one end near the coil terminal, and then passing the other hand down the length of the tube, extinguishing the glow and giving the effect, as a friend expressed it, of "wiping the moonshine off."

Many other combinations will suggest themselves to the investigator, but there is one experiment which, since it depends upon a principle that has not, to the writer's knowledge, received as yet any published explanation, should be of special interest.

This phenomenon, a description of which has already appeared in

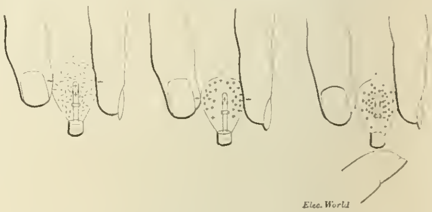


FIG. 3.

these columns,* may be satisfactorily observed with the small induction coil by proceeding as follows:

Holding the bulb of a miniature incandescent lamp in the hand, bring the leading-in wire into contact with the coil terminal; the bulb will be filled with the usual phosphorescent glow. If, now, the lamp is slowly withdrawn from contact with the terminal, this light will gradually fade, as the confines of the field are approached, and concentrate itself around the interior carbon. Soon a point will be reached beyond which the glow does not diminish through further removal from the coil. It is now quite self-sustained, and cutting the current off from the coil will not effect it in any perceptible way. This phenomenon we have called the "afterglow."

When obtained in this way, the afterglow will continue for from one to two minutes after the coil is shut off. The lamp may be carried glowing from room to room; if put down out of the hand the light becomes fainter, but is not extinguished. After some minutes, when the glow has faded quite away, a sudden flash may be observed if the leading-in wire is touched with the finger. Several of these flashes may sometimes be obtained before the bulb is entirely discharged.

It must not be supposed that this glow is due to heat remaining in the lamp carbon, the heating effect of so weak a coil being quite insignificant. A consideration of the accompanying figures will show the purely electrostatic nature of this phenomenon.

When the lamp is withdrawn from the alternating field, the interior electrode retains a charge differing in sign or intensity from that of the rarefied gas in the bulb and that induced in the fingers of the experimenter, Fig. 3. The natural consequences of this state of unequal charge are molecular bombardments and collisions more violent in the immediate neighborhood of the electrode, because of the small surface over which its charge is distributed. When electrical equilibrium has been established between the gas molecules and the electrode, this interchange of charge ceases, and the glow dies away. The condition of affairs at this moment is shown in Fig. 4.

Discharging the electrode will now cause a sudden rush of molecules toward it to re-establish equilibrium (see Fig. 5), giving rise to the momentary flash observed, and this may be repeated until no charge remains in the lamp.

This is, perhaps, the simplest arrangement ever devised for obtaining light from electricity, and it may not be extravagant to say that it embodies the fundamental principles of an economical system of artificial illumination.

*"The Afterglow in Exhausted Bulbs," The Electrical World, Jan. 20, 1894.

Electricity in Church

Electricity has not occupied so prominent a place in the church as the ease with which it lends itself to decorative and illuminating purposes would seem to warrant. Perhaps it is because the church is more conservative than the world and less inclined to don the garb of modern civilization; or possibly it is because of that ancient superstition of man that a "dim religious light" is more conducive to a spiritual mood than any artificial glare. Into many churches, however, and especially those of very recent construction, the electric light has made its way and has proved so thoroughly satisfactory as to become indispensable. It is often the case, unfortunately, that the lights are so few, and installed with so little regard to brilliancy of effect or harmony with architectural details, that the result is far from pleasing.

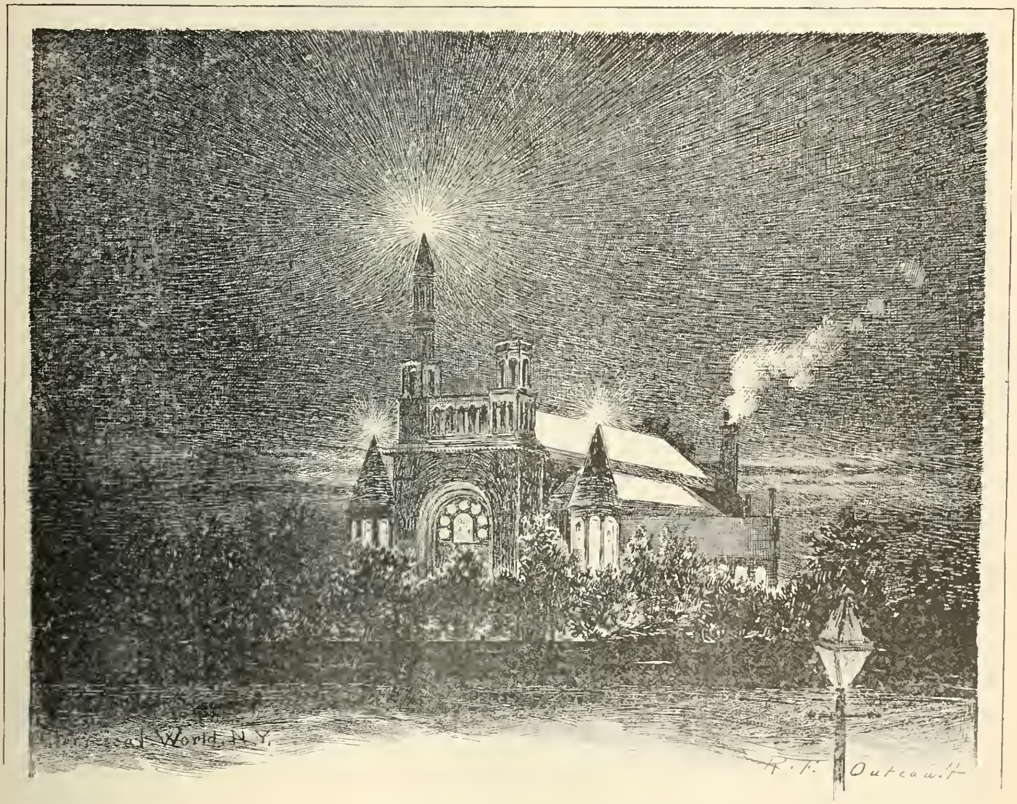
The First Baptist Church, which stands on the northwest corner of the Boulevard and West Seventy-ninth street, New York City, has been unusually progressive, and has sanctioned the use of electricity not only as a means of illumination, but for other purposes as well, ministering to the convenience and comfort of the pastor and the congregation.

The church occupies a prominent site on the boulevard and its grace and harmony of design reflect much credit upon the architect, Mr. Geo. Keister. The building is Byzantine in style, the material of the outside being buff Indiana limestone with the face point-tooled. The base is of Milford granite. The Spanish tile roof is of yellowish brown color, in keeping with the general tone of the exterior.

The interior of the church is very attractive and embodies some quite novel ideas. The special feature of the building may be considered its shape and the lighting of the auditorium. The auditorium is elliptical in form with its major axis on the diagonal of the lot, which is approximately 100x105 feet in area. The inside measurements of the ellipse of the auditorium are 59x101 feet, and the highest point in the ceiling is 72 feet from the floor.

It is perhaps the ceiling itself which presents the most striking peculiarities of construction. It is made up of a grand vault thirty feet in diameter, with two half vaults—one on either side—of almost the same diameter, forming large coves. The upper portions of the vaults—about two-thirds of the whole—are of leaded glass covered on the outside with ordinary three-eighths inch rubber skylight glass, glazed on the rake of the roof, which is nearly 45 degrees. The daylight is taken through this leaded glass and gives a strong and powerful illumination with practically no shadows.

At night the auditorium is lighted by 240 incandescent lamps concealed behind the leaded glass between it and the plain glass



The Church by Night.

roof. The light is reflected through the leaded glass, the individual lamps not being visible, as they are in all cases from seven to nine feet from the glass. In addition to these lights there are 60 lamps concealed in the apse of the church and not visible in the auditorium except by reflection, while about 70 more are distributed over the choir gallery, being shaded to light the music, and placed behind an arch at the back of the auditorium for the purpose of lighting up a large rose for effect on the outside front. The remainder of the lights installed are distributed about the building on the ordinary combination fixtures.

The Old and the New.

It will be seen that the scheme for lighting is a novel and interesting one. The interior effect is most pleasing, as will appear from the illustration on the opposite page. The light is soft and distributed with unusual evenness, so that one can read with ease in any part of the church. But perhaps the most striking part of the plan is the effect from the outside. The light streaming through the glass roof makes it one broad sheet of light, at first giving the impression that the building is on fire. A group of lights on the top of the steeple heightens the effect, and with the light which pours through the roof and windows, instantly challenges the attention of the Boulevard pedestrian, who might easily persuade himself that he was in Madison Square and gaze aloft in search of the gilded form of the fair "Diana." It was not the original intention to have the roof of clear glass, as much of the light is thus lost, but it was finally concluded that a part of the brilliancy on the interior could be sacrificed in order to attract the attention of the outside world. One of the difficulties incidental to this method of lighting is that unless the leaded glass, behind which the lights are placed, is kept reasonably clean, the light is considerably reduced. Provision was made for walking over and sweeping off the glass, but the sexton, doubtless thinking discretion the better part of valor, has manifested an unfortunate disinclination to trust himself upon anything but the main floor.

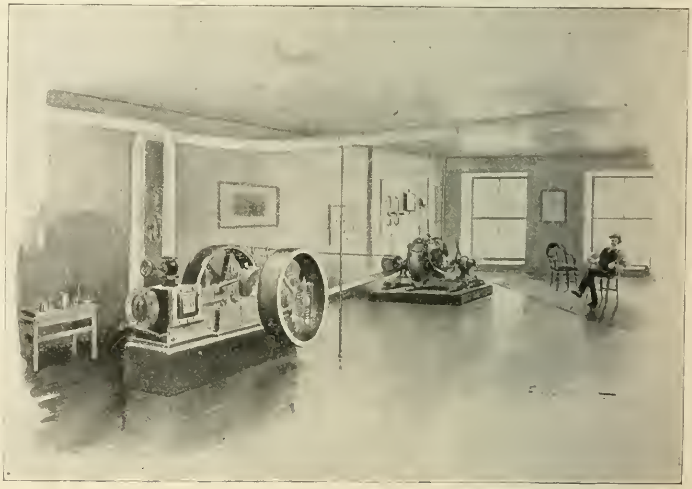
Electricity is not used for lighting alone in this progressive church. The patient organ blower has been replaced by an equally patient and much more reliable form of motive power—a small electric motor. The organist has also arranged an ingenious electrical device, through which, by manipulating keys on one of the key boards, he can play a chime of bells. The pastor himself has established electrical signals between the ante-room and the pulpit and the organist, so that he can inform the latter when he is ready to come on to the platform or has nearly finished his sermon.

A very pretty little effect is produced by the employment of the electric light in an altar lamp, shown in one of the accompanying illustrations. This lamp is almost a history of lighting in itself, uniting as it does the most ancient and the most modern forms of illumination.

The dynamo plant is shown in one of the accompanying illustrations. The generator is a 25 kw. bi-polar, compound wound "C. & C." machine, running at 900 revolutions, driven by a high-speed "Atlas" engine. The switchboard is equipped with the usual measuring and indicating instruments and switches. Messrs. H. Ward Leonard & Co. were the electrical contractors.

Altogether, the First Baptist Church of New York may be considered to be one of the most perfectly appointed, from an electrical standpoint, of any in the country. It is believed to have been the first in which an isolated plant was installed.

A Suggestion.



The Dynamo Room.

Injurious Static Discharges.

A correspondent informs us of a curious experience he recently had with a 35-kw 500 volt motor. One morning the attendant noticed a bad flash between the poles, which apparently came from the armature. On testing, a short circuit was found, and upon taking the motor apart it was discovered that the insulation was burned off a small spot on two adjacent coils and the wires partially fused together. The next morning at about the same time the same thing occurred again, and it was concluded after closely watching the phenomenon that the cause was a static discharge due to the effect of two large belts running quite near, though well grounded collectors were in position over and under the belts. After grounding the bed of the motor, however, there was no more trouble. Our correspondent cannot explain why the coils should fuse together in the same manner every time, though this might have been due to the carbonized insulation acting as a conductor. The motor had been running over two years previously under the same conditions without any trouble being developed.

Interior View of the Church.

1894 Annual Meeting of the American Association for the Advancement of Science Aug.

The meetings of the Association were brought to a close on Wednesday last. With the exception of the papers before the Physical Section (B) on Monday, comparatively few papers were presented which were of real interest to the electrical profession. In Section A Ormond Stone read a paper on "A Simple Proof of Radau's Symmetrical Form of the Differential Equations of Relative Motions of the Planets;" Aaron N. Skinner a paper on "Sketch of Zone Observations at the Naval Observatory;" and Edgar Frisbee, the new vice-president of the section, a paper on "Gilliss' Catalogue of Southern Stars."

Before the section of Mechanical Science and Engineering, Prof. Plympton delivered an address on "Some Reminiscences of the Early History of Iron Bridge Building in the United States," in which he recalled some interesting incidents in iron bridge construction, from its inception in 1856.

In the Physical Section (B), however, some interesting and valuable papers were read on Monday, the last day of the meeting of this section. Prof. Samuel Sheldon presented a paper on "A Calorific Effect of the Velocity of Migration of Hydrogen Ions." Prof. Sheldon exhibited the phenomenon of the "pail forge" as it was shown at the World's Fair last year. A large electrode of lead was placed in a jar which is filled with any kind of conducting fluid and has a layer of sand at the bottom. A bar of iron of small cross section is made the cathode for the current. When the small electrode is placed in the liquid there is a great production of light and heat in the part immersed. Prof. Sheldon has found from his own experiments and those of others that one electrode must be large compared with the other, the heating taking place at the small electrode; that any electrolyte or conducting liquid may be used. There is an unstable period while gas bubbles come off; with sufficient electromotive force the luminous envelope is produced, the color of which depends on the electromotive force, the electrolyte and the electrode. The current is steady and relatively small. The electromotive force varies as the specific resistance of the solution; it is independent of the nature of the electrode, but depends on its form and size. The theory of the phenomenon advanced is as follows: The inability of hydrogen ions to travel beyond a certain velocity results in a heating of the cathode, if sufficient electromotive force is applied, so that Faraday's law requires the hydrogen to migrate faster than its maximum velocity.

A paper on "The Radiation of Obscure Heat by a Metal Mass," was read by Prof. B. W. Snow. A mass of cast-iron weighing one hundred pounds heated to 100 C° or cooled to 0° C′ was placed near one of the bars of the inferential comparator, and the expansion or contraction of the bar was noted. It was found that at first but little effect was produced. Soon, however, the bar expanded or contracted according to the temperature of the mass near it, and reached a maximum nearly two hours after the mass was placed in position. The bar then tended to resume its normal length, and reached that condition not less than twenty-four hours after the effects of the mass had first been detected.

"The Infra-Red Spectra of Metals," was the subject of a paper by E. P. Lewis and E. S. Ferry. This paper is simply a preliminary notice of work now in progress. The method consists in the use of a diffraction grating of 21 feet 6 inches focus, with 1,400 lines per inch, in connection with a bolometer and galvanometer. The galvanometer has a sensitiveness of 10^{-9} and the galvanometer of .00001 dyra centigrade. The bolometer is arranged differentially so as to eliminate the effect of the flickering of the arc. The region thus far investigated extends to wave length 12,000 Agstrom units. Several lines have been located, but the wave length not yet actually determined. Among such lines are two pairs of Sodium lines of wave lengths approximating 8,190 and 8,200, and 11,468 and 11,488. These observations agree very well with values obtained from the empirical formula of Keyser and Runge.

Dr. F. Bedell, in his paper on "Magnetic Potential," pointed out the effect of permeability upon the magnetic potential at a point due to magnet or to a current of electricity.

C. J Rolleson presented a paper on "A Phonographic Method for Recording the Alternating Current Curve." To produce the alternating current curve by the aid of the phonograph two operations are necessary; first, a record of the curve must be produced on the wave cylinder of the phonograph; second, the record produced in the first operation must be magnified by means of a suitable multiplying arrangement. The method seems especially adapted for the study of harmonics in the alternating current. By the aid of König's apparatus the number of harmonics present may be determined, and perhaps their relative intensities. Their relative positions may then be determined by plotting the curve. These operations may be repeated several times, and thus each operation may serve as a check on the others.

"A New Recording Thermometer for Closed Spaces," was described by W. H. Bristol, of Stevens Institute. A coil in the closed space or oven where the temperature is to be measured is connected to the recording part by means of a small copper tube. The recording part may be 25 feet or more from the point at which the temperature is to be measured. The coil is partly filled with alcohol and the air is exhausted. When the coil is exposed to the high temperature, pressure is produced corresponding to the temperature. The pressure is communicated to the recording gauge through the small connecting tube, which becomes filled with condensed vapor of the alcohol; thus the indications of pressure are not affected by ordinary changes of temperature in the room where the recording part is located. A special feature of this instrument is that the graduations on charts are very open on the upper portion of the scales.

"On Some Magnetic Characteristics of Iridium," was the subject of a paper by Prof. S. H. Brackett, in which he gave an account of examinations and tests of iridium showing characteristics which do not appear to have been noted before. The iridium was prepared by John Holland, and stated by him to be free from iron. In the magnetic field a bar is more readily magnetized transversely than longitudinally, as ordinary stroking methods of magnetizing produce very irregular distribution of magnetism. The magnetic intensity, compared with that of steel, is as 1 to 12. The largest bar used was about 2½ cm. long. Special apparatus was constructed to test the permeability, which was found to be practically zero. Position or movement in a magnetic field is not sufficient to magnetize it; it must be jarred. By magnetizing in that way in contact with the poles of an electro-magnet, and using different strengths of current, the curve of susceptibility was obtained. Examination of the distribution was made by means of a small suspended magnet; also apparatus was constructed for magnetizing by octuple touch, that is, stroking the four sides at once. Low permeability, great coercitive force, and a magnetic intensity not recorded before, are claimed as results of the investigation.

A paper on "Lightning as a Case of the Dissipation of Energy" was read by N. D. C. Hodges. A few years ago, by looking through the records of lightning disasters, Mr. Hodges hit upon the idea of the lightning dispeller. It consists of one or more thin copper ribbons running from the highest point on the building to be protected to the lowest, at intervals of thirty or forty feet. This ribbon runs seventy-five feet to the ground, and is so put on as to insure its destruction by the lightning. The deflagration of such a conductor, Mr. Hodges said, has invariably been found to result in the protection of all else. Mr. Hodges' philosophy is this: Lightning destroys; that is, there is power in it which manifests itself in broken masonry, etc. This energy must be used up on something. He does not know how much energy it takes to deflagrate a pound of copper; he only knows that no lightning discharge has ever manifested enough energy to deflagrate more than two or three pounds. He also gave his theory of the stress in electrified air, and stated that there might be a foot pound of energy in every cubic foot. In discussing the paper, Prof. MacFarlane made a calculation on the blackboard from Mr. Hodges' data. According to Mr. Hodges a cubic mile of air might discharge its energy in one flash; this

would be represented by a number involving twelve figures. A rough calculation of the energy required to deflagrate a pound of copper gave it as a number involving six figures only. The one quantity was one million times the other. He also showed that a man would in 75 minutes do as much work as was involved in deflagrating Hodges' pound of copper, and asked whether a man, working at an average rate for 75 minutes, could split a great tree, such as we see done by a discharge of lightning. Prof. McAdie asked Mr. Hodges whether he had read Lodge's book, and he also quoted Lord Kelvin's saying that a properly constructed system of lightning conductors gave us a very comfortable protection against a thunderbolt.

The last paper was by Alexander McAdie, on "Some Peculiar Lightning Flashes." In June, 1894, one hundred persons were killed by lightning in the United States; in July the number was at least as great. Accurate knowledge about lightning discharges is, therefore, of practical importance. So far, all photographs of flashes exhibit the flash in one flame, not in space. To obtain the correct path in space it is necessary to have two or more photographs taken from very different points of view. Mr. McAdie had three cameras pointed at the summit of the Washington monument in the city of Washington—one at the Capitol, 1.4 miles distant; a second at Fort Meyer, 4 miles distant, and the third at the Weather Bureau, 1.3 miles distant. He showed photographs of some peculiar flashes; a multiple meandering flash, an impulsive rush with dark flashes along its side, a flash ending in a cloud, and a flash with bright side flashes.

On Monday afternoon, through the courtesy of Mrs. J. S. T. Stranahan, the scientists enjoyed an excursion to various points of interest about the bay. On Thursday a large number of members and their friends made a trip up the Hudson to West Point, returning in the afternoon in time to connect with the Providence steamer for the excursion to the White Mountains, under the auspices of the American Forestry Association.

The officers chosen unanimously by the association for next year's meeting for sections A, B, and D are as follows: President, E. W. Morley, Cleveland, Ohio; vice-presidents, mathematics and astronomy, E. S. Holden, Lick Observatory: physics, W. Le C. Stevens, Troy; mechanical science and engineering, William Kent, Passaic, N. J.; secretary of the Council, Charles R. Barnes, Morrison, Wis.; secretaries of the section, mathematics and astronomy, E. H. Moore, Chicago; physics, E. Merritt, Ithaca; mechanical science and engineering, H. S. Jacoby, Ithaca.

It was announced that the new members added to the association at the Brooklyn meeting numbered 213, and that forty-eight had been elected Fellows for "eminent services to science." Dr. William H. Hale was reinstated as one of the original Fellows from 1874.

San Francisco was indicated as the place of next meeting, provided suitable reduction of rail fare can be secured.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

This association was organized at the World's Engineering Congress at Chicago last year, and now comprises among its 150 members many of the well-known engineering educators of the country. The meetings were held on Monday, Tuesday and Wednesday of last week, and a number of interesting papers were presented, many of which, however, were only read by title. Prof. De Volson Wood, of Stevens Institute, as president of the society, delivered a very able address on "Technical Education." Prof. F. O. Marvin, of Kansas State University, took up the question of "Entrance Requirements Common to All Engineering Schools." He believed that some standard should be adopted throughout the country, and outlined what he thought constituted the proper requirements for admission to a high grade engineering school. He recommended that the society should appoint a committee to consider the question and report at the next meeting.

"Engineering Education and the State University" was the subject of an interesting and instructive paper by Prof. W. S. Aldrich, of the University of West Virginia, in which the author ably considered the question of the engineering school in connection with the State University.

"Graduate and Post-Graduate Engineering Degrees" was a subject which aroused considerable interest and was participated in by Profs. Palmer C. Ricketts, of the Rensselaer Polytechnic Institute, George F. Swain, of the Massachusetts Institute of Technology, and Robert H. Thurston, director of Sibley College, Cornell University. Prof. Ricketts said that the engineering course pursued, and not the degree, counts, and that after an engineer has had some experience and has become a member of a recognized engineering society, he very seldom uses his school degree, but adopts the abbreviations of the professional society instead. Dr. Thurston believed that the form of the degree ought to depend upon the nature of the course. In some schools a liberal education is given to students along with engineering science. Others have a more distinctly professional aim, assuming that the student is already trained in the liberal art and wishes to take up engineering as his life work. The general consensus of opinion seemed to be that the old academic degrees were not of much use.

Prof. Mansfield Merriman, of Lehigh University, read a paper on "Teachers and Text-books in Mathematics for Technical Schools." He pointed out that teachers of pure mathematics in engineering courses of study are most successful when in close sympathy with technical practice. Mathematics is to the engineer a tool for the solution of problems in investigation and design, and hence practical problems could be chosen for the illustration of principles and methods.

Prof. J. B. Johnson, of Washington University, St. Louis, Mo., spoke on "The Teaching of the Specifications and the Law of Contracts to Engineering Students." He recommended the preparation of a small text-book containing a synopsis of the law of contracts and a description of the various documents entering into an engineering contract.

Prof. J. J. Flather, of Purdue University, read a paper on "Teaching Mechanical Drawing and Lettering in Engineering Schools," in which he emphasized the importance of both mechanical and free-hand drawing. As drawing is the language of the engineer, it is of the greatest importance that the student be properly taught to express himself, and that his methods conform to those in vogue among practical men. The machine shop drawing is simply a memorandum, showing what is to be produced. It is necessarily an illustrated memorandum, and to be perfect, it should answer all questions which a workman can reasonably ask in regard to the work. It is not necessary to have a finely finished drawing, in fact, shop drawings should not be finely finished. As free-hand sketches enter largely into the work of engineering, the importance of teaching free-hand drawing cannot be over-estimated, and although it may not be generally considered as mechanical drawing, yet its common use in the drawing room and shop entitles it to be properly classed under this general head. Exercises in lettering should begin with the first work in free-hand drawing and should be continued throughout the entire course.

Prof. Storm Bull, of the University of Wisconsin, spoke on "Some German Schools of Engineering." He described the various engineering schools of Germany, notably those at Berlin, Dresden, Munich and Karlsruhe, and the Polytechnikum at Zurich, Switzerland. Of the German schools, that at Berlin has altogether the best equipment and strongest teaching force. The result is that the number of students at that school is nearly two thousand, Munich coming next with 1,800. The Prussian government is doing its utmost to concentrate everything at Berlin, taking the best professors of the other engineering schools in Prussia to Berlin as soon as a vacancy occurs, the result being that these other schools in Hanover, Aix La Chapelle, etc., have not been able to keep up with the better schools. The school at Zurich stands alone and has in some respects the best equipment. The number of students is about 1,300, of which about one-half are foreigners, coming from all parts of the world. The method of instruction in all these schools is by means of lectures. At Zurich these lectures are supplemented by weekly reviews, with compulsory attendance, whereas in all the schools of Germany no restrictions are placed on the students, so that they may work or not as they please. It was stated that the result is that the students at Zurich work very much harder than the students at the German engineering schools. Dr. Bull thinks the lecture system as practiced at Zurich the best method of instruction for juniors and seniors in our engineering schools, especially if the professor furnishes notes of the lectures beforehand. He states that in general the mechanical laboratories are very poorly equipped in all the schools mentioned, and that very little laboratory work is required of the engineering students. The same is true of work in the machine shops.

Perhaps the most interesting paper, from an electrical standpoint, was that of Prof. D. C. Jackson, of the University of Michigan, on "Electrical Engineering Laboratories," an abstract of which will be found in another column.

The following officers were elected for the ensuing year: President, Prof. George F. Swain, of the Massachusetts Institute of Technology; Vice-Presidents, Dr. R. H. Thurston, Director of Sibley College, Cornell University, and Professor F. O. Marvin, of the University of Kansas; Secretary, Prof. J. B. Johnson, Washington University; Treasurer, Prof. Storm Bull, University of Wisconsin.

British Association Meeting at Oxford.

Abstracts of the Marquis of Salisbury's presidential address and the addresses of the presidents of Sections A (Mathematical and Physical Science) and G (Mechanical Science), as well as a number of the papers read before the Oxford meeting of the British Association, have already been presented to the readers of the Electrical World. The following synopsis of the daily proceedings of the society may be found of interest:

Lord Salisbury delivered his address on Wednesday, August 8, while the addresses of the presidents of Sections A and G were made on Thursday, August 9. In Section A, after the delivery of the presidential address, a paper on "Preliminary Experiments to Find if Subtraction of Water from Air Electrifies It," by Lord Kelvin and Messrs. MacLean and Galt was read, an abstract of which was printed in The Electrical World of last week. Prof. Quincke, of Heidelberg, and Profs. Lodge, J. J. Thomson and Fitzgerald questioned the validity of the method of experiment, pointing out the various ways in which the results might be accounted for. Prof. Schuster defended it, and Lord Kelvin, in reply, stated that Prof. Schuster was quite right. The next paper was on "Preliminary Experiments for Comparing the Discharge of a Leyden Jar Through Different Branches of a Divided Channel," an abstract of which appeared in our last issue, describing some researches recently carried out by Lord Kelvin and Mr. Galt. In the discussions, Dr. Lodge gave an interesting account of his theory of the alternative path in condenser discharges, and explained why it is that an iron path has a greater damping effect than a copper one. The morning session was concluded by a paper by Dr. Lodge on "Photo-Electric Leakage," in which he described the experiments of Hertz, Lodge, Elster and Geitel on the effects of ultra-violet and polarized light in the diselectrification of positively and negatively electrified surfaces.

On Friday, August 10, the chief electrical papers were presented in Section B, which is usually occupied with chemical subjects. A discussion on "The Behavior of Gases with Regard to Their Electrification and the Influence of Moisture on their Combination," had been arranged for, and the first paper on the subject was contributed by Prof. J. J. Thomson, and dealt with the resistance of electrical stress for gases in various degrees of moisture, Prof, Thomson's remarks being illustrated by a number of experiments. The two succeeding papers showed that, in certain cases at any rate, there is a parallel between the electrical and the chemical importance of aqueous moisture in gases. The reading of these papers was followed by an informal but interesting discussion, participated in by Prof. Schuster, Mr. Baker and Prof. J. J. Thomson. In the meantime, before the combined sections of A and G, a discussion had been going on on the subject of "Integrators, Harmonic Analyses and Integraphs, and their Application to Physical and Engineering Problems." The discussion was opened by Prof. Henrici, who exhibited some of his own instruments. A debate on "Flight" before the combined Sections had drawn in also a large portion of the audience of Section B. The discussion of this subject was opened by an address by Lord Kelvin on the resistance of solids moving through fluids. Mr. Maxim then described his flying machine, after which Lord Rayleigh asked and replied to the question: What is a flying machine?

On Saturday, August 11, on account of the large number of contributions to Section A, a division was made; one sub-section taking up a list of some fifteen mathematical papers, while another considered the reports of various committees and some physical papers, and a third dealt with papers of a physical-chemical nature. The mathematical sub-section adjourned until Tuesday. In the second sub-section Prof. Osborne Reynolds showed an interesting series of experiments on the boiling of water in an open vessel with a constricted tubular orifice. In the physical-chemical sub-section, two electrical papers were discussed, one by Mr. H. Stansfield on "The Relation Between the Surrounding Gases and the Electrical Conductivity of Thin Soap Films," and the other by Mr. W. C. Dampier-Wetham on "The Velocity of the Hydrogen Iron Through Solutions of Acetates." Meanwhile Section G had busied itself with three important papers, including one by Mr. B. Donkin on "The Most Economical Temperature for Steam Engine Cylinders."

On Monday, August 13, in section G (Mathematical Science) the first paper was by Mr. W. H. Preece on "Signalling Through Space," to which we refer editorially, in which he reviewed his researches in this method of signalling, and concluded with particulars of his most recent work on the subject. Prof. S. P. Thompson then presented his paper, abstracted elsewhere in this issue, on "Some Advantages of Alternating Currents," which was followed by one by Mr. T. Parker on the "Continuous Current Distribution of Electricity at High Voltage, Being a Description of the Lighting of the City of Oxford;" the result was a spicy discussion by the authors of the two papers. In the Physical Section (A) Dr. A. Schmidt read a paper on "A New Analytical Representation of Terrestrial Magnetism," which proved to be an extension of Gauss's expression enabling the internal and external components of the terrestrial force to be expanded in separate terms. (This paper apparently deals with the same subject as that of L. A. Bauer, read before the American Association for the Advancement of Science, and abstracted in our last issue.) A paper by Prof. Schuster was then read on "Suggested Explanation of Secular Variations of Terrestrial Magnetism," an abstract of which will be found in the Electrical World of August 25. In a paper on the Minimum Current Audible in the Telephone," Lord Rayleigh showed that the degree of sensitiveness depends on the nearness of the frequency of the impulses to the natural periods of vibration of the disc, the greatest sensitiveness being obtained when the frequency of impulse was identical with the natural frequency of vibration. Several other papers were also read, the subjects being chiefly of minor electrical interest.

On Tuesday, August 14, a joint discussion took place before the physical and physiological sections on theories of vision, which was inaugurated by some brilliant experiments and two important papers by Prof. O. J. Lodge. The first paper was on "Experiments Illustrating Clerk Maxwell's Theory of Light," in which the phenomena of electromagnetic radiation were very beautifully and convincingly demonstrated. This paper was introductory to the one on "An Electrical Theory of Vision," which immediately followed, and its direct purpose was to initiate the physiologists into the researches of Hertz, Lodge and others on the subject of electromagnetic waves. Prof. Lodge, in his second paper, disclaimed the intent of advancing a "theory" of vision, and urged that his communication was rather in the nature of a question put to physiologists as to whether it is possible that anything resembling the action of electromagnetic waves on a coherer could be supposed to take place in the vertebrate eye. The gist of Prof. Lodge's hypothesis is, that a simple electric circuit, consisting of a coherer contact and an otherwise closed circuit, with or without a seat of electromotive force, may be taken as an analogue and considered to be an enlarged model of the mechanism of vision. Lord Rayleigh, in the discussion which followed, after congratulating Prof. Lodge on the ingenuity of his hypothesis, stated to the Physiological Section, that physicists could object neither to the Young-Helmholtz theory nor to that of Henry, provided that three independent variables in the system of equations were granted. There might be six variables in all, three dependent and three independent. The discussion was also participated in by Profs. Burdon-Sanderson, Schafer, Armstrong and others. A division of the Section then occurred, one portion being occupied with papers on optics, while the other considered papers relating to electrical standards. The formal report of the Committee on Electrical Standards was read by Mr. R. T. Glazebrook. Prof. Viriamu Jones communicated the results of a "Determination of the International Ohm in Absolute Measure." Lord Rayleigh said that no method previously used for finding the ohm could compete in point of accuracy with that used by Prof. Jones. In the meantime Section G had been listening to a number of important papers, among which was the valuable report of the Committee on Dryness of Steam, submitted by Prof. Unwin, and a paper on the "Hunting of Governed Engines," by Mr. J. Swinburne.

On Wednesday, August 15, the sessions were very short and a number of the papers were withdrawn. In the Physiological Section two interesting papers were read, one by Profs. Lodge and Gotch on "Some Physiological Effects of the Passage of Rapidly Alternating Currents of Great Intensity Through Nerve," and the other by Mr. G. J. Burch on the "Production with the Capillary Electrometer of Photographic Records of Currents Produced by Speaking with a Telephone." The Oxford meeting of the Association was concluded in a general meeting held at half-past two in the afternoon, when the Association adjourned. The next meeting will be held at Ipswich.

The largest number of papers in any single section was presented in Section A, but the honors of the session may possibly be claimed by the Chemical Section, in which the chief sensation was the announcement by Lord Rayleigh and Prof. Ramsey of the discovery of a new substance in the earth's atmosphere resembling nitrogen.

Dynamo-Electric Machinery—V.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Fig. 16 shows a duodeci-polar alternator. The wires, a, a, are in circuit with the field magnets, and serve to carry the current which excites them, while the wires, b, b, lead from the brushes.

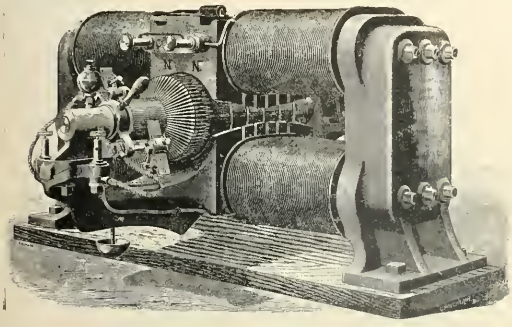


FIG. 14.—CONTINUOUS CURRENT CONSEQUENT POLE BI-POLAR GENERATOR, SHUNT WOUND.

16. Dynamo-electric machines may also be divided, according to their magnetic circuits, into the two following classes:

(a.) Those having simple magnetic circuits formed by a single core and winding,

(b.) Those having consequent poles, or poles formed by a double winding; that is, by the juxtaposition of two poles of the same name. Dynamo-electric machines belonging to the first class are shown in Figs. 1, 3 and 5. A type of machine belonging to the cousequent pole class is shown in Figs. 14 and 15. The poles are

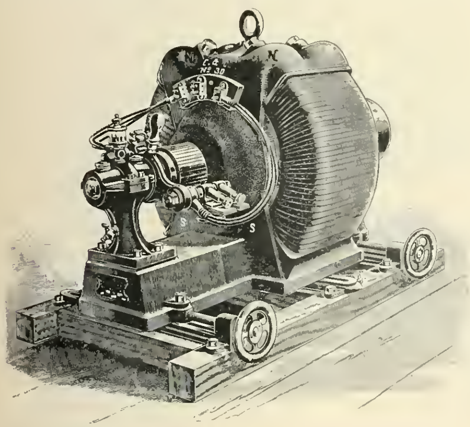


FIG. 15.—CONTINUOUS CURRENT CONSEQUENT POLE BIPOLAR GENERATOR.

shown at N, N and S, S, in each case, the field coils being so wound and excited as to produce this effect.

17. Dynamo machines may also be classified according to the shape of the armature, as follows, namely:

(a.) Ring armatures.
(b.) Cylinder or drum armatures.
(c.) Disc armatures.
(d.) Radial or pole armatures.
(e.) Smooth core armatures.
(f.) Toothed core armatures.

Figs. 2 and 11 represent examples of ring armatures.

Since Gramme was the first to introduce this type of armature, it is frequently called a Gramme-ring armature. Figs. 1, 5 and 14 show examples of cylinder or drum armatures. Disc armatures are very seldom employed in the United States. An example is shown in Fig. 19. An example of a radial or pole armature is seen in Fig. 17.

A smooth core armature is one on which the wire is wound over the cylindrical iron core, so as to completely cover the armature surface; or, if the wire does not cover the surface completely, the space between the wires may either be left vacant or filled with some non-magnetic metal. Such armatures are represented in Figs. 1, 2, 5, 15.

A toothed-core armature, on the other hand, is one on which the

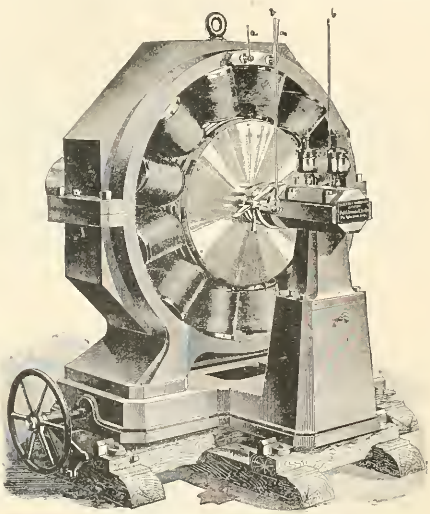


FIG. 16—ALTERNATING CURRENT SEPARATELY-EXCITED DUODECI-POLAR GENERATOR.

wire is wound in grooves or depressions, on the surface of the laminated iron core, so that the finished armature presents an iron surface, but with slots containing insulated copper wire. Such an armature is shown in Fig. 18 and also in Figs. 7, 10 and 11.

18. Dynamos may also be divided according to the actual or relative movement of armature or field, into the following classes, namely:

(a.) Those in which the field is fixed and the armature revolves. This class includes all the machines previously described, except that represented in Fig. 19.

(b.) Those in which the armature is fixed and the field revolves. An example of this type of machine is shown in Fig. 19, where two

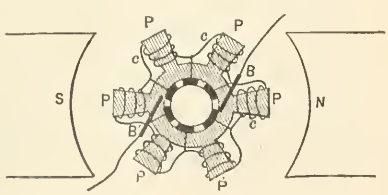


FIG. 17—DIAGRAM OF POLE ARMATURE.

sets of field magnets, mounted on a common shaft, revolve together around a fixed disc armature which is rigidly supported vertically in the space between them.

(c.) Those in which the field and armature are both fixed, but the magnetic connection between the two is revolved. These dynamos are usually called inductor dynamos.

19. Dynamo machines may also be divided according to the character of the work they are intended to perform, into the following classes, namely:

(a.) Arc-light generators.
(b.) Incandescent-light generators.
(c.) Plating generators.

(d.) Generators for operating motors.

(e.) Telegraphic generators.

(f.) Therapeutic generators.

20. Alternating current generators may be divided according to the number of separate alternating currents furnished by the machine in to the following classes, namely:

(a.) Uniphase alternators, or those that deliver a single alternating current. To this class of machines belong all the ordinary alternators employed for electric lighting purposes.

(b.) Multiphase alternators, or those that deliver two or more alternating currents which are not in step.

Some multiphase alternators can supply both single phase and multiphase currents to different circuits.

Multiphase machines may be further sub-divided into the following classes, namely:

(1.) Diphase machines, or those delivering two separate alternating currents. These two currents are, in almost all cases, quarter-

Fig. 18—A Toothed-Core Armature Showing the Stages of Winding.

phase currents, that is to say, they are separated by a quarter of a complete cycle. Such machines, when necessary, may be called diphase-quarter-phase machines. Although it is possible to employ any other difference of phase between two currents, yet the quarter phase is in present practice nearly always employed.

Fig. 9 represents a diphase generator.

(2.) Triphase machines, or those delivering three separate alternating currents. These three currents are, in all cases, separated by one third of a complete cycle.

Uniphase machines sometimesare called single-phase machines, and diphase machines are sometimes called two-phase machines or two-phasers, while triphase machines are sometimes called three-phase machines or three-phasers. The terminology above employed, however, is to be preferred.

21. In addition to the above classification there are the following outstanding types:

(a.) Single-field-coil multipolar machines, or machines in which multipolar magnets are operated by a single exciting field coil.

(b.) Commutatorless continuous current machines, or so-called unipolar machines, in which the E. M. Fs. generated in the armature being obtained by the continuous cutting of flux in a uniform field, have always the same direction in the circuit, and do not, therefore, need commutation. The term unipolar is both inaccurate and misleading, as a single magnetic pole does not exist.

(To be continued.)

Electric Lighting in Great Britain—III.

BY E. RAY STEVENS.

But few of the public plants have been established long enough to judge fairly of the results of operation. Bradford has been operating its plant as long, if not longer, than any other British city. It is now five years since it was established, and figures for the first four years of operation are available. During this period the capital of the plant had been doubled by extensions to meet the increased consumption, which, in 1893, was over 480,000 Board of Trade units, or over four times what it was in 1890.

The gross revenue from the plant has increased from $12,000 in 1890 to $50,000 in 1893. During the first year of operation the plant paid a gross profit of more than $1,500; this surplus last year was $25,000 over and above all the actual expenses of operation. The city has each year set aside a sum for interest, taxes, depreciation and sinking fund, which last year amounted to $16,000.

In order to give a clearer idea of the various items of cost, they have been calculated upon the basis of the standard unit rather than given in a lump sum. The standard unit is fixed by the Board of Trade to be a current sufficient to supply fifteen incandescent lamps of sixteen candle power for one hour. The cost of repairs and maintenance per unit has in the four years been reduced from 1.34c. to .74c., the cost of oil, waste, engine room stores and carbons from .3c. to .12c., wages from 3.46c. to 2.1c., and the cost of coal from 2.18c. to 1.32c. It should be said that coal cost but 92c. per unit in 1892, but that the miners' strike and consequent scarcity of coal caused it to be unusually dear last year. The total cost of production and distribution, including such charges as rents, taxes and office expenses, was in 1890 8.2c. per unit., in 1891 was 5.94c., and in 1892 and 1893 5.14c. The percentage of the total cost to the total revenue has decreased from 85.94 in 1890 to 49.15 in 1893, so that the gross profit last year was over 50 per cent., after paying all operating expenses, yet the price charged is lower than in all the other thirty cities for which figures have been obtained with the exception of four.

Bradford is the only one of these thirty-one cities which does not charge rent for the meters used. The average price charged last year was 10.16c. per unit. This certainly is a very favorable showing for the first four years of operation. But the city suffers from the disadvantage of having purchased machinery which is somewhat inferior to that now manufactured. It will doubtless be

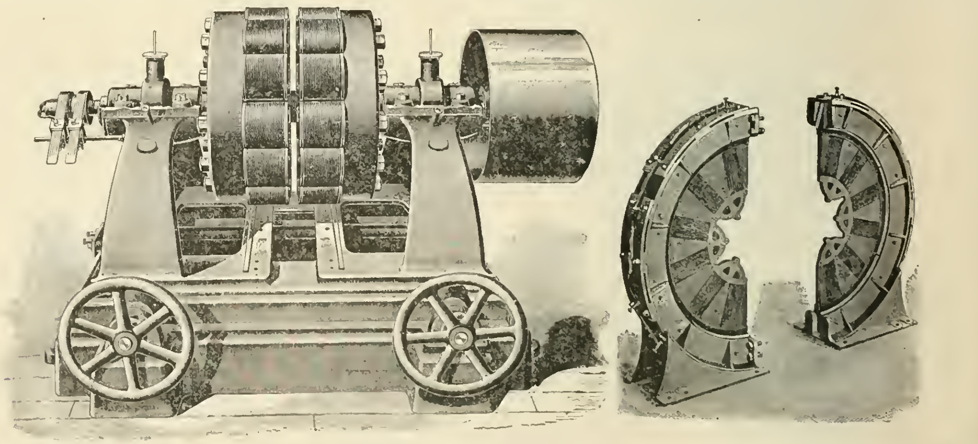


Fig. 19—Alternating Current Double-Duodecipolar Generator with Fixed Armature and Revolving Field Frames.

compelled in the near future to replace the old machinery by that which is more improved.

Among the other most successful public plants is that of the Saint Pancras Vestry in London, which has a capitalization of $480,000. The gross revenue rose from $55,000 in 1892 to $75,000 in 1893, while the gross profit increased from $12,500 in 1892 to $30,000 in 1893. But the average price for these two years was raised from 11.3c. to 11.68c. per unit. The amount set aside last year for interest, depreciation and sinking fund was $23,000, leaving a surplus of $7,000 on the undertaking. The consumption last year was nearly 595,000 units.

In detail the cost of the coal used was 3.32c. per unit in 1892 and 2.46c. in 1893; the cost of oil, water, carbons, etc., was .68c. per unit

in 1892 and .58c. last year; wages cost 2c. last year, a reduction of .72c. per unit from the previous year; repairs and maintenance cost .38c. in 1892 and 1.18c. last year. The total cost per unit of all expenses of manufacture, distribution and management was 9.32c. in 1892 and 7.1c. last year. St. Pancras, owing, doubtless, to the exceptional conditions of the local government of London, does not pay taxes. But as far as I have been able to learn, this is the only example of a public lighting plant that does not meet its full share of taxes, including those for education and the poor, even though the plant has neither children to educate nor paupers to maintain.

Brighton began to operate its plant in 1892. The consumption, revenue and gross profits of the undertaking were in 1893 nearly double what they were in 1892. The amount of each item of expenditure per unit was reduced except that spent for repairs and maintenance, and the total cost was lowered from 7.52c. in 1892, to 5.92c. in 1893. The average price charged was reduced from 13.96c. to 12.36c. per unit, and the percentage of gross profits rose from 47.56 to 54.03. The consumption last year was 286,895 units.

Glasgow began the operation of a plant last year that had not by the close of the year met running expenses. It is operated in conjunction with the municipal gas plant, and the deficit was met by the profits of that industry. Huddersfield, in July, 1893, began the operation of a model plant equipped almost entirely with American machinery. The revenue of the first six months was over $5,000, which has been doubled during the last half year. This is sufficient to more than meet all expenses of operation, but does not meet the heavy contribution to the sinking fund, which must in thirty years extinguish the debt of $210,000 for establishing the plant.

Among the most successful of the public plants established last year is the one at Manchester, which, during the first eight months of operation, paid all but $600 of the expenses and fixed charges, such as interest and sinking fund. The gross profit was over $23,000. The average price charged was 11c. per unit, and the average total cost 6c. per unit. The present year will show still better returns, for so popular is the light that the present capacity of the plant has been entirely exhausted, despite the fact that it was thought that it would supply all demands for a half decade at least. 439,379 units were consumed during the first eight months of operation. Extensions will be made at once.

Of the other public plants that at Hull made a gross profit during the first year of its operation of $4,400. This, however, was not sufficient to meet all fixed charges, such as interest and sinking fund. The total cost per unit was 10.06c., and the average charge 14.14c. The plant at Dublin paid a gross profit of $7,500 last year. The total cost per unit was 8.18c., and the average charge 9.76c.

The other cities in which public operation of electric lighting plants has recently been begun, or is about to be begun, are Nelson, Bristol, Richmond, Aberdeen, Edinburgh, Accovington, Bedford, Blackburn, Blackpool, Burnley, Burton-on-Trent, Cheltham, Derby, Dundee, Great Yarmouth, Kingston-upon-Hull, Kingston-upon-Thames, Lancaster, Leicester, Nottingham, Oldham, Portsmouth, Salford, Stafford, Walsall, Wolverhampton, Bolton, Worcester, Cardiff, Coventry, Dewsbury, Ealing, Hauley, Londonderry, Newport, Southport, Sunderland, Tunbridge Wells, Halifax, Whitehaven and Taunton. Many other cities have secured the provisional orders, but have not established plants as yet, and still others are now taking steps to secure the necessary orders from the Board. These facts show a rapid increase in the number of public plants in the United Kingdom, which at present is greater than that of private undertaking.

London, England.

(To be Continued.)

Electric Belts in England

An English court has given judgment to the London "Electrical Review" in the last of several suits brought on by scathing criticism of electric belt venders, in all of which our public-spirited English contemporary has been victorious The present suit was an action for maintenance brought by the proprietors of the "Electrical Review" against one Harness, and the Medical Battery Company, Limited, of which company Harness was managing director. The Medical Battery Company was incorporated for the purpose of carrying out the treatment of diseases by means of electric and magnetic appliances. They manufactured a belt which was thought suitable for such treatment, and, as part of their establishment, they founded and maintained an institution called "The Electropathic and Zander Institute," with Harness at its head. In January, 1892, the "Electrical Review" published an article by way of protest against certain appliances and electric belts which had been publicly exhibited by the company at the Crystal Palace, as being constructed in direct opposition to the most elementary laws of electricity, and in July and September of the same year published other articles against the Institute and against Harness, its president. As a result of these articles the Medical Battery Company brought an action against the journal in September, 1892. The pleadings in that action were completed, but no notice of trial was ever given, and in April, 1893, the action was discontinued. In that same September another article appeared in the "Electrical Review," commenting in very strong and adverse terms upon a report which had recently been written and published by one Dr. Tibbits, testifying to the great value of the institution, its apparatus, appliances and electric belts. The article reflected seriously upon the character and conduct of Dr. Tibbits in connection with that report, and also upon the Zander Institute and its appliances, and the conduct of Harness as its manager and vendor of the belts bearing his name, and Dr. Tibbits, in October, 1892, commenced an action for libel against the journal. The action came on for trial before Mr. Justice Mathew on February 15, 1893, and it resulted in a verdict for the "Electrical Review" on the ground of privileged criticism. The costs of this action Dr. Tibbits was unable to pay, and the last action was brought against Harness and the Medical Battery Company, to recover the damages sustained by the journal, upon the ground that the former unlawfully maintained Dr. Tibbits in bringing and prosecuting his action. Judgment was entered for the "Electrical Review" and a stay denied except in consideration of a deposit of £500 paid into court, or security for that amount.

Mail Service by Trolley.

The transportation of mails by trolley cars was begun in Brooklyn recently, when a trial trip of the new trolley postal car on the lines of road controlled by the Brooklyn Traction Company on the Atlantic

Electric Mail Car.

Avenue and Brooklyn, Bath and West End systems between the Brooklyn post office and Coney Island was made. The route was made a mail route recently by the post office department. The new combination mail car, one half of it fitted up as a mail distribution car and the other half to carry passengers, takes the following route: Adams street, Court square, Boerum place, Atlantic avenue, and Fifth avenue, to Thirty-sixth street, and thence over the route of the West End road, in New Utrecht avenue, to West Brooklyn, Blythebourne, Van Pelt Manor, Bath Beach, Bensonhurst, and Unionville to Coney Island. Mails for all these various post offices are carried and distributed in the car, and at certain points in the city collectors meet the car, and carry the mail to branch post-offices, and deliver what is to be sent to the outlying stations on the outward trip, and to the general post office on the return trip. It is thought that the collection and delivery of mails will be expedited by several hours under the new system. Three trips a day will be made. The car, which is shown in the accompanying illustration, is not an old surface car remodeled as a makeshift for the postal service, but a new one made from designs furnished by Postmaster

Sullivan and by the railway mail department. It is of the regulation size and is divided into two sections by a partition across its centre. The forward half is fitted up for the railway mail service, with iron racks for the pouches, a distributing table extending all along one side for the sorting, separating and stamping of mail matter, and with a set of pigeon holes for distributing. The rear half of the car is to be used by smokers, and it has seats around three sides. The windows of the postal compartment are protected by a wire netting, so that while the windows may be open in warm weather there is no possibility of any of the mail matter being blown out of the windows. All the woodwork that is exposed is of polished maple, and the roof is finished in white enamel with gilt ornaments. The car is lighted by electricity and is also supplied with electric heaters. The outside of the car presents a striking appearance, being finished in white enamel with the lettering in gilt. Running along the side of the mail compartment of the car are the words, "United States Mail," and the smoking compartment is designated by the words, "Smoking Car." In the centre is the number of the car, 101, and along the space just over the wheels are the words, "Atlantic Avenue Railroad Company."

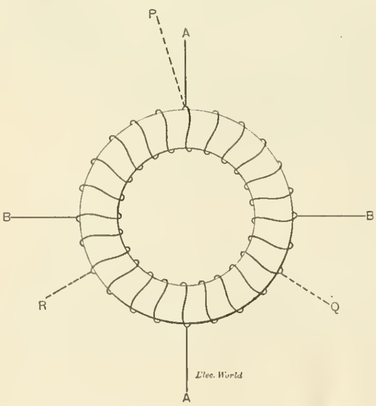
The Wenstrom Company.

The Fort Wayne Electric Company has purchased the Wenstrom Electric Company, of Baltimore, for the purpose, it is reported, of obtaining control of the Wenstrom patents. These patents, it has been claimed, cover some important points in dynamo and motor construction and are generally infringed by manufacturers of electrical machinery. There are rumors that an active fight will be at once begun against all of these alleged infringers.

Some Advantages of Alternating Currents.*

BY S. P. THOMPSON.

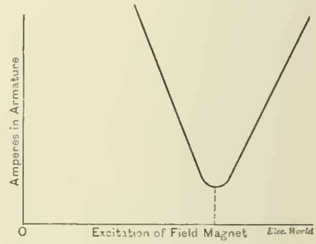
After referring to the advantages of the alternating current for high voltages, and on account of lacking sliding contacts, its greater safety, greater adaptability for regulation and absence of electrolytic effects on insulation, a method somewhat similar to that of Mr. C. F. Scott, is described for transforming three-phase currents into two-phases and vice versa, which was first published in a lecture before the Royal Institution on February 23, 1894, some days in advance of the paper of Mr. Scott, which was read at Washington on March 7, 1894. If a Gramme ring is connected, as shown in the



PHASE TRANSFORMER.

figure, to a two-phase system with 100 volts between A, A, and 100 volts in quadrature between B, B, a three-phase set of alternating currents may be taken off from the same winding at any three equidistant points P, Q, R, at pressures 66 volts between each of the three wires. The magnetic field across the coil revolves, and it is preferable to provide a laminated core to complete the magnetic circuit. Such a core may be stationary or may revolve. It is no exaggeration to say that an electrical engineer, starting, let us say, with three-phase alternate currents as the method of supply, is in a position to furnish any customer who may desire either two-phase currents or single-phase currents with what he wishes by merely putting in a small appropriately connected transformer.

Another advantage of alternating currents arises in its application to electro-magnets. It has long been known that the magnetic forces of a magnet fall off very rapidly at small distances from their poles. For steel magnets, in those cases in which the poles can be considered as points, the force falls off inversely as the square of the distance, other things being equal. In the case of soft iron electromagnets operated by continuous currents, the pull on their armatures falls off much more rapidly than this. The forces when in contact may be relatively enormous, and yet the magnet may have no range of attraction worthy of mention. A pull of 150 lbs. in contact may dwindle to a few ounces at a distance of a couple of inches. With alternating currents, however, supplied at constant



INDUCTION MOTOR EXCITATION CURVE.

voltage from the mains, the author finds all this to be different. With a properly-designed and well-constructed electro-magnet, the pull on its armature can be kept fairly constant over a considerable range; nay, in some cases can be caused to be *greater at a distance than when near.* For example, an alternating current magnet the pull of which, when excited at 50 volts, was 8 oz. when the armature was closely in contact with the core, exercised a pull of 32 oz. when the space between them was 3 inches. This obviously introduces into electric mechanism a new element hitherto undreamed of.

The secret of these things is that in the case of alternating current electro-magnets, the self-inductive reaction of the system also enters, and not merely the electric *resistance* of the wires. Whereas Ohms' well-known law for continuous currents is

$$\text{Current} = \frac{\text{electromotive force}}{\text{resistance,}}, \text{ or } C = \frac{E}{R}$$

The rule that governs the alternating current in these cases is different, being

$$\text{Current} = \frac{\text{electromotive-force}}{\text{impedance}}, \text{ or } C = \frac{E}{\sqrt{R^2 + L^2\omega^2}}$$

where $\omega = 2\pi \times$ the frequency of the alternating current, and L is the inductance. As the armature of the alternating current magnet is withdrawn from the core, the inductive reactance diminishes and more current flows, making the pull greater at a distance instead of less.

Another curious point about alternating current magnets relates to their winding. In the case of electro-magnets supplied with continuous currents, it is well known that the more turns of wire that are wound on the core, the more powerfully is it magnetized. But with alternate current magnets this is not so. There is one particular number of windings for each magnet, generally a small number, for which the magnetism is a maximum, and any additional wire wound on above this number diminishes instead of increasing the magnetic power.

After referring to the inductive drop on alternating current lines and the manner in which it may be counteracted by condensers, it is pointed out that another remedy is possible, which must before long become general when its advantages are known. In 1892 Mr. Mordey gave at the Institution of Electrical Engineers some results of alternating current working, including a very remarkable curve, here reproduced, showing the dependence of the armature current upon the excitation of the field magnets of a synchronous motor when loaded with a given load. To this curve and its meaning the author directed attention at the time, and he has since given much thought to it. It will be found to be most significant. The curve presents the form of a letter V. The lowest point corresponds to a particular state of things, namely: that the motor having its magnetism excited to a particular degree, draws a certain

* Abstract of a paper read before the British Association at Oxford,

minimum amount of current from the mains in order to drive its mechanical load at the speed imposed upon it. But to do the same work—drive the same load at the same speed—will take more current from the mains if the excitation of the magnets is either more or less than this particular amount. This seems very strange, but the explanation and its consequences are no less so. The particular stage of excitation which makes the armature current a minimum for the particular load in question is that stage which corresponds to there being no difference of phase between the pulsations of impressed voltage and those of the resulting current. Suppose, for example, the armature had a resistance of $\frac{1}{2}$ ohm, and that the current was supplied at 100 volts, and that a current of 10 amperes was found the minimum current that would drive the load, it would be found (approximately) that the excitation corresponding to this minimum current would be such as would make the motor work with a back electromotive force of 95 volts; for then, by Ohm's law, $(100 - 95) \div \frac{1}{2} = 10$ amperes. But, now, suppose the excitation is lessened, the machine acting at the same unaltering speed will generate less than 95 volts; suppose it drops to 90 volts. Then, if nothing else happened, the current would increase to $(100 - 90) \div \frac{1}{2} = 40$ amperes. But 40 amperes at 90 volts is much more power than 20 amperes at 95 volts, and is more than is wanted for the load—what must happen? The machine is synchronous, and cannot—physically cannot—run faster so as to take up this power. It tries to do so, with the result that it shifts the phase of its reactions, the current now lagging in phase behind the impressed electromotive force—choked down, in fact, from the 40 amperes to something more than 20—choked down, in fact, to such an amount as would, if multiplied by the cosine of the angle of lag, and by the 90 volts, come up to the same product as the original volts and amperes, namely, $95 \times 10 = 950$. The synchronous motor, *if under-excited*, acts then as a choking coil, producing a reactive drop. But continue the argument the other way: Suppose the excitation is increased so that the 95 volts become 100 volts, when $(100-100)\ \frac{1}{2} = 0$; and there would be no current at all to drive did not again an adjustment of phases come into play. Instead of the current dropping to zero, more current than before now comes into play, and that current has its pulsations in advance of those of the impressed voltage, there being now an angle of *lead* in the phase relations. In other words, the synchronous alternating motor, *if over-excited*, acts as a condenser, and, instead of producing a drop in the voltage, tends to raise it by compensating the inductive drops due to self-induction in other parts of the circuit. When the importance of this deduction from Mr. Mordey's curve dawned upon the author, he began to prepare to test it upon the mains of the City of London Electric Lighting Company. But before any experiments could be even arranged, he learned that the same conclusions had been arrived at by the officials of the General Electric Company, at Lynn, Mass., and that they had found it in practice to work out favorably. They found that in a line where self-induction played the part of a choking coil, it did not matter very much whether the voltage needed for driving the current through the line and machines were situated mainly in the generator or in the motor, as the mean voltage in the line was not far from a mean between that of the two. Accordingly, in a three-phase power transmission at Hartford, Conn., of 300 kilowatt output, the motor was arranged to be over-excited. Later, after Mr. Steinmetz had submitted the question to calculation, this feature was introduced into the synchronous motors used in all their recent power transmissions, so that by proportioning the armature reaction and the over-excitation to the self-induction likely to arise, the voltages on the circuit remain quite constant, regardless of load, within the limits of the capacity of the machines.

The advantages to be derived from over-excitation have indirectly another advantage—namely, that for single transmission cases the motor and the generator may be designed and constructed as identical machines, instead of the motor being made smaller than the generator. Further, the regulation of the voltages in such a network as that of the City of London Electric Lighting Company, instead of being made more difficult when motors are much used—as was feared by some engineers—will be more easy, provided the motors are of the over-excited synchronous type. For, the acceleration of phase these produce in the current not only tends to compensate for the inductive drop in mains and transformers, but tends to react right back through the system to the generators in the central station, acting on them as a compound-winding would do, and assisting them not only to counteract the inductive drop, but also the ohmic drop, both between the consumers' lamps and the distributing points, and also between these points and the generating station.

So manifest is this advantage that it would seem worth while to erect at one, or possibly more, points of the network, as remote as possible from the generating station synchronous motors over-excited, to act as condensers in compensating the inductive drop; or in the primary circuit also, to furnish the idle currents for magnetizing the transformer primaries.

Electrical Engineering Education.

From a paper on "The Equipment for Electrical Engineering Laboratories," read by Prof. D. C. Jackson before the Society for the Promotion of Engineering Education, and unfortunately too long to reprint in full, we extract the following paragraphs:

In dealing with electrical engineering laboratories, it is assumed that they are attached to an engineering department over which a professor of electrical engineering presides. The electrical engineering department is therefore separated entirely from the physics department, and is coördinate with the other departments of engineering. The practice, at present common in many colleges, of placing the electrical engineering course, with its class room and laboratory instruction, under the direction of the professor of physics, is just as absurd as it would be to devolve upon that professor the instruction in advanced thermodynamics and the design and construction of steam engines. It is equally absurd for the professor of electrical engineering to attempt to teach physics. Proper instruction in physics is essential to the student who is pursuing a course in electrical engineering, and the physics department must be well controlled and supplied with an excellent independent laboratory equipment. In addition to the ordinary general course in physics, the electrical engineering student should gain, during his coursein physics, a common sense grasp of the elementary motions of electricity and magnetism and of the "all pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as galvanometers, bridges, voltameters, amperemeters, voltmeters, etc. Before beginning his work in electrical engineering, the student's knowledge of Ohm's law and its common results should have become almost instinctive. The student should also become acquainted with the theory and practice of photometry. This should all be done in the physics department and the equipment required for the instruction should be controlled by that department. Much of this equipment is quite different from that required by the electrical engineering department, but some of it is useful to both departments and, where students are not too numerous, may be used to some degree in common.

It seems best to arrange the professional electrical studies for the average electrical engineering student in four divisions, in three of which laboratory work must be made an integral part of the instruction in a satisfactory course. The divisions are:—

1st. Electro-magnetism and its applications to special uses, with special reference to dynamos and motors. 2d. Electro-chemistry (including primary and secondary batteries) and electo-metallurgy. 3d. Alternating currents and alternating current machinery, including alternators, transformers, motors, condensers, etc. 4th. The special applications of the preceding divisions in electric light, power, railway, mining, telegraph, telephone and other types of plants. These divisions are of about equal real moment, but the last must be alloted more time in the lecture room than either of the others, though little or no laboratory time or equipment need be directly allotted to it. The equipment that can be made useful in the fourth division is usually of an illustrative nature, and must be a matter of slow growth and collection as the electrical industries progress, rather than of immediate selection.

While higher mathematics is a useful aid in each of the divisions, its limitations as an agent must be carefully shown in the classroom and laboratory. For the purpose of educating the judgment of a student and fully defining the limitations of theories and mathematical deductions, the laboratory is indispensible and the equipment should be selected with this object in continual view. The equipment should be so selected and be of sufficient amount, that as much as one half of the total time spent by the student under the direct instruction of the professors of electrical engineering may be profitably devoted to the laboratory. The equipment, moreoever, should be such that the work may, as far as possible, deal with fixed commercial instruments and machinery, and actually follow the methods of testing and research used in practice. The first three divisions should each be properly represented by a commercial laboratory equipment, in which every principle and operation is illustrated and made useful in every-day instruction

under the direction of a man who has had experience in similar commercial work. The laboratory work must always go hand in hand with the class-room work, illustrating and strengthening the latter. In this way the equipment may be made most effective in the work for which it is designed. It is well to remember that engineering measurements are almost invariably quantitative, and that the results from an engineering investigation which bear fruit are also nearly always quantitative. It is seldom that purely qualitative results may be accepted as satisfactory in engineering work. Therefore the laboratory equipment must be capable of doing quantitative work which is in general of satisfactory commercial accuracy, and which may be made rigorously exact for purposes of exact investigation.

In determining the course of study to be pursued by the electrical engineering undergraduate, upon which the course of laboratory work must depend, it must unfortunately be remembered that he cannot confine his attention to electrical engineering during the whole time given to professional work in his course. He must gain an elementary but practical knowledge of thermodynamics and hydraulics, with an efficient knowledge of their application in steam and water power plants. He must also get a common sense knowledge of the principles underlying the design, manufacture, and selection of machinery. In fact, he must receive a good working knowledge of the problems of the mechanical engineer. Laboratory courses are likely to fail when not properly balanced, on account of a failure to educate the common sense or judgment of students, the students thus leaving college without having gained an all-round capacity for practical work and research which is necessary to put them in a fair way to become useful engineers. The knowledge of the electrical engineer must be based on the honest, well-tried mechanical laws, and he must go into a study of all that will aid most in putting him in the way to make a thorough electrical engineer.

Practical Notes on Dynamo Calculation—XV.

BY ALFRED E. WIENER.

c. Bearings.

To determine the size of the armature-bearings, ordinary engineering practice ought to be followed. In machine design, on account of the increased heat generation at higher velocities, it is the rule to provide a larger bearing-surface the higher the speed of the revolving shaft. This rule may, for dynamo shafts, be expressed by the formula:

$$l_b = k_{10} \times d_b \times \sqrt{N}, \ldots\ldots\ldots (82)$$

where l_b = length of bearing, in inches;
d_b = diameter of bearing, in inches, from formula (76);
N = speed of shaft in revolutions per minute;
k_{10} = constant depending upon kind of armature and on output of dynamo. (See Table XLI.)

The numerical values of k_{10} range between .1 and .225 for high speed armatures, and from .15 to .3 for slow speed armatures, as follows:

TABLE XLI.—VALUE OF CONSTANT IN FORMULA FOR LENGTH OF ARMATURE BEARINGS.

Capacity in Kilo Watts.	Value of Constant k_{10}.	
	High Speed Armatures.	Slow Speed Armatures.
Up to 5	.1	.15
" 10	.1	.175
" 50	.125	.2
" 100	15	.225
" 500	.175	.25
" 1,000	.2	.275
" 2,000	.225	.3

Applying these values to formula (82) and using the journal diameters previously determined, the following Tables XLII., XLIII. and XLIV. are obtained, giving the sizes of bearings for drum-armatures, high-speed ring armatures and slow speed ring armatures respectively:

d. Pulley and Belt.

The pulley diameter is determined by the speed of the dynamo and the linear belt velocity:

$$d_p = \frac{12 \times S_b}{\pi \times N} = 3.7 \times \frac{S_b}{N}; \ldots \ldots (83)$$

d_p = diameter of pulley, in inches;
S_b = belt speed, in feet per minute, see Table XLV.;
N = speed of dynamo, in revs. per minute.

TABLE XLII.—BEARINGS FOR DRUM ARMATURES

Capacity in Kilo-Watts.	Value of Constant k_{10}.	Speed in Revs. per Min. (from Table VIII.) N.	Size of Bearing. Diameter (from Table XXXVIII.) d_b	Length $l_b = k_{10} \times d_b \times \sqrt{N}$.	Ratio $l_b : d_b$
.1	.1	3,000	3/16	1	5.3
.25	.1	2,700	5/16	1 5/8	5.2
.5	.1	2,400	7/16	2 1/8	4.9
1	.1	2,200	9/16	2 5/8	4.7
2	.1	2,000	3/4	3 3/8	4.5
3	.1	1,900	15/16	4	4.3
5	.1	1,800	1 1/8	4 3/4	4.2
10	.1	1,700	1 5/8	6 3/4	4.2
15	.105	1,600	1 7/8	7 7/8	4.2
20	.11	1,500	2 1/8	9	4.2
25	.115	1,350	2 3/8	10	4.2
30	.12	1,200	2 1/2	10 1/2	4.2
50	.125	1,050	3	12	4.0
75	.13	900	3 5/8	14	3.9
100	.14	750	4 1/8	15 3/4	3.8
150	.15	600	4 3/4	17 1/2	3.7
200	.16	500	5 1/4	18 3/4	3.6
300	.175	400	6	21	3.5

TABLE XLIII.—BEARINGS FOR HIGH SPEED RING ARMATURES.

Capacity in Kilo-Watts.	Value of Constant k_{10}.	Speed in Revs. per Min. (from Table IX.) N.	Size of Bearing. Diameter from Table XXXIX. d_b	Length $l_b = k_{10} \times d_b \times \sqrt{N}$.	Ratio $l_b : d_b$
.1	.1	2,600	1/4	1 1/4	5
.25	.1	2,400	3/8	1 7/8	5
.5	.1	2,200	1/2	2 3/8	4.75
1	.1	2,000	5/8	2 3/4	4.4
2.5	.1	1,700	1	4 1/8	4.1
5	.1	1,500	1 3/8	5 1/8	3.9
10	.11	1,250	1 3/4	6 3/4	3.85
25	.12	1,000	2 5/8	10	3.8
50	.13	800	3 1/2	13	3.7
100	.15	600	4 3/4	17 1/2	3.7
200	.16	500	6 3/8	23	3.6
300	.17	450	7 1/2	27	3.6
400	.175	400	8 1/2	30	3.5
600	.18	350	10	33 1/2	3.35
800	.19	300	11	36	3.3
1,000	.2	250	12	38	3.2
1,500	.21	225	14	45	3.2
2,000	.225	200	16	51	3.2

TABLE XLIV.—BEARINGS FOR SLOW Stud ~~SPRING~~ RING ARMATURES.

Capacity in Kilo-Watts.	Value of Constant k_{10}.	Speed in Revs. per Min. (from Table X.) N.	Size of Bearing. Diameter (from Table XL.) d_b	Length $l_b = k_{10} \times d_b \times \sqrt{N}$.	Ratio $l_b : d_b$
2.5	.15	400	1 1/8	3 3/8	3
5	.16	350	1 1/2	4 1/2	3
10	.17	300	2	5 7/8	2.9
25	.18	250	3 1/4	8 3/4	2.8
50	.19	200	4 1/4	11 1/2	2.7
100	.20	175	5 3/4	15 1/4	2.65
200	.21	150	7 3/4	20	2.6
300	.23	125	9 1/8	23 3/4	2.6
400	.25	100	10	25	2.5
600	.265	90	12	30	2.5
800	.27	80	13 1/2	32 1/2	2.4
1,000	.28	75	15	36	2.4
1,500	.29	70	18	43 1/2	2.4
2,000	.30	65	20	48	2.4

TABLE XLV.—BELT VELOCITIES FOR HIGH SPEED DYNAMOS OF VARIOUS CAPACITIES.

Capacity in Kilo-watts.	Belt Speed in Feet per Minute. S_b
Up to 5	2,000 to 3,000
2.5 " 25	3,000 " 4,000
10 " 100	4,000 " 5,000
50 " 500	5,000 " 6,000

The belt-speed in modern dynamos ranges between 2,000 and 6,000 feet per minute, as above:

The pull at the pulley circumference, in pounds, is:

$$F_p = \frac{33{,}000 \times \text{h.p.}}{\frac{d_p \times \pi}{12} \times N} = \frac{33{,}000 \times \text{h. p.}}{S_b} = 44.2 \times \frac{W}{S_b}$$

For an arc of belt contact of 180°, which can safely be assumed for dynamo pulleys, the pull, F_p, is to be multiplied by 1.4 in order to obtain the tension on the tight side of the belt; hence the greatest strain upon the belt:

$$F_b = 1.4 \times F_p = 62 \times \frac{W}{S_b}$$

Allowing 300 lbs. per square inch as the safe working strain of leather, the necessary sectional area of the belt can be found from

$$b_b \times h_b = \frac{F_b}{300} = .2 \times \frac{W}{S_b}; \ldots\ldots\ldots (84)$$

b_b = width of belt, in inches;
h_b = thickness of belt, in inches;
W = capacity of dynamo, in watts;
S_b = beltspeed, in feet per minute, Table XLV.

The approximate thicknesses for the various kinds of belts are:

Single belts.................. $h_b = \frac{3}{16}$ in.
Light double belts............ " $= \frac{9}{32}$ "
Heavy double belts.......... " $= \frac{11}{32}$ "
Three-ply belt................ " $= \frac{7}{16}$ "

Inserting these figures in (84), the width of the belt is obtained:

Single belts........ $b_b = \frac{.2}{\frac{3}{16}} \times \frac{W}{S_b} = 1.1 \times \frac{W}{S_b}$ ....(85)

Light double belts...$b_b = \frac{.2}{\frac{9}{32}} \times \frac{W}{S_b} = .7 \times \frac{W}{S_b}$ ....(86)

Heavy double belts..$b_b = \frac{.2}{\frac{11}{32}} \times \frac{W}{S_b} = .6 \times \frac{W}{S_b}$ ....(87)

Three-ply belts......$b_b = \frac{.2}{\frac{7}{16}} \times \frac{W}{S_b} = .45 \times \frac{W}{S_b}$ ....(88)

Single belts are used for all the smaller sizes, up to 100 kw. output, light double belts up to 200 kw, heavy doubles up to 400 kw., and three-ply belts for capacities from 400 kw. up.

Based upon the above formulæ the author has prepared the following Table XLVI., from which the belt dimensions for various outputs and for different belt speeds can readily be taken:

TABLE XLVI.—SIZES OF BELTS FOR DYNAMOS.

Capacity of Dynamo in Kilo-Watts.		Thickness of Belt, Inch	Width of Belt. Belt Speed, in Feet per Minute: 2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000
			inches	inches	inches	inches	inches	inches	inches	inches	inches
1	Single Belt	$\frac{3}{16}$	.6	.5	.4	..	..	..	..	..	..
2		$\frac{3}{16}$	1 1	.9	.7	..	..	..	..	..	..
3		$\frac{3}{16}$	1.7	1.3	1.1	1.0	.8	..	..	..	..
5		$\frac{3}{16}$	2.75	2.2	1.8	1.6	1.4	..	..	..	..
7.5		$\frac{3}{16}$	4.1	3.3	2.75	2.4	2.1	..	..	..	..
10		$\frac{3}{16}$	5.5	4.4	3.7	3.1	2.75	2.5	2.2	..	..
15		$\frac{3}{16}$	8.25	6.6	5.5	4.7	4.1	3.7	3.3	..	..
20		$\frac{3}{16}$	11.0	8.8	7.3	6.3	5.5	4.9	4.4	..	..
25		$\frac{3}{16}$	..	..	9.2	7.9	6.9	6.1	5.5	..	..
30		$\frac{3}{16}$	..	..	11.0	9.5	8.25	7.3	6.6	..	..
40		$\frac{3}{16}$	..	..	14.7	12.6	11.0	9.8	8.8	..	..
50		$\frac{3}{16}$	..	..	18.3	15.75	13.75	12.25	11.0	10	9.2
60		$\frac{3}{16}$	..	..	22.0	18.9	16.5	14.7	13.2	12	11.0
75		$\frac{3}{16}$	..	..	27.5	23.5	20.5	18.5	16.5	15	13.75
100		$\frac{3}{16}$	..	..	..	..	27.5	24.5	22	20	18.5
150	Double Belt.	$\frac{9}{32}$	..	..	..	..	26.2	23.5	21	19	17.5
200		$\frac{11}{32}$	..	..	..	..	30.0	26.75	24	21 8	20
250		$\frac{11}{32}$	..	..	..	..	37.5	33.5	30	27.5	25
300		$\frac{11}{32}$	..	..	..	..	45	40	36	32.75	30
400	3-ply.	$\frac{7}{16}$	..	..	..	..	45	40	36	32.75	30
500		$\frac{7}{16}$	..	..	..	..	56.5	50	45	41	37

The width of the belt being thus determined. the breadth of the pulley-rim is found by adding from one-half to two inches, according to the width of the belt.

(To be continued.)

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—I have been watching with much interest the discussion that has been carried on for the last two or three weeks in your columns regarding the practical importance of a true sine curve in alternating current work.

I became personally deeply interested in the matter during my work on induction motors, and conducted, last year, some experiments to determine the actual practical bearing of the difficulties indicated by theory. Of these latter there can be no reasonable doubt, as the demonstration has been thoroughly given by Rowland and others.

The questions that appeared for solution were: (1) Does a wide departure from a sine curve in an alternating current cause such serious effects as to practically interfere with the successful operation of induction motors? (2) If the difficulty really exists practically, how far will it appear in alternators as generally constructed?

These questions were not of theory, but of fact. To answer the first one, my experiments took the following form:

I set up a 15 h. p., three phase induction motor, the properties of which were well known to me. Two sources of power were prepared, either of which could be easily shifted in the motor line by throwing the switch. One of these was a smooth-core three-phase generator, worked at high magnetization, the curve from which had been obtained and was known to be a very close approximation to a sine wave. The other was an iron-clad generator, the curve of which was never exactly a sine wave, and which was deliberately distorted by greatly weakening the field and allowing the armature reaction full play. By suitable banks of transformers, power was delivered to the motor at the same voltage from each machine. I then had a careful efficiency curve of the motor taken, involving a large number of readings, which were obtained from the two currents alternately. The conditions of operation of the motor, which was loaded by being belted to a direct current generator, were thus exactly the same, except in the form of current wave delivered. The result of this experiment showed very distinctly that the sine-wave current had the advantage. The differences observed were not great, but were quite unmistakable. That they were no larger is very likely due to the fact that the third harmonic, usually the most important one, tends to help the armature of the three-phase type of motor.

Having settled this question, I next took up the bearing of the answer on commercial machines. From previous and subsequent experiments with the same motor, I found that the result obtained from the known sine wave did not vary within the limits of experimental error from those obtained by using our ordinary iron clad three-phase generators under commercial working conditions. These experiment were the basis of the statement which I made last winter in a paper before the American Institute of Elecrical Engineers, to the effect that so far as practical operation was concerned, no serious difficulties were to be apprehended from variations from the sine wave such as would be found in good commercial machines. This position I believe to be correct, certainly so far as three-phase apparatus is concerned.

The experiences of Mr. Scott and Mr. Kelly confirm mine as regards the bad effect of wide variations. The trouble which they seem to have had with the commercial machines is, however, much greater than I have ever been able to find even when looking for it, posssibly owing to a worse current curve than I ordinarily obtained, or to difficulties inherent in the motors.

I may casually add that condensers would be very unfavorably affected by variations from the sine wave.

To sum up, I think I can safely say from the concurrence of experiments conducted on the three types of induction motors manufactured in this country, that *considerable* variations from the theoretical form of current wave are serious in their effects. I believe that we also may conclude that in most polyphase generators, even those designed without great attention to the form of wave, no variations of much practical importance are likely to be found. This is certainly true with respect to the three-phase type. I think the effect of an irregular current curve is more to be dreaded, commercially speaking, on the line than in the motors, especially in long distance transmission.

I fancy that the somewhat radical opinion expressed in the London "Electrician" was due merely to unfamiliarity with induction motors, and not to any ignorance as to the theoretical questions involved.

Chicago, Ill. LOUIS BELL.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO PHYSICS.

Starting an Arc.—A new method of Mr. Belloc is described in "L'Elec." August 4 and "La Lum. Elec.", July 28; the arc is started by means of sparks from an influence machine whose poles are connected to the points between which the arc is formed; if sufficiently powerful, sparks will be formed even though the air gap is shunted by the battery or dynamo; he gives the maximum distances for a 50 volt battery for carbon, copper and zinc, the greatest being 3.5 mm. for the latter when unlike poles of the two sources are connected, and least for carbon; with a 4-plate Holtz machine the distance can be as much as 7 to 8 milimeters with zinc terminals.

Atmospheric Electricity and Solar Radiation.—A translation of an article by Messrs. Elster & Geitel from "Wied. Ann.," No. 48, p. 338, on "Observations on the Gradient of Atmospheric Potential and on the Radiation of Ultra-violet Light from the Sun," is given in abstract in the Lond. "Elec.," August 10.

Form of Periodic Currents.—An Academy paper by Mr. Janet, describing an electro-chemical method for recording the forms of curves, is given in "L'Ind. Elec.," August 10.

Specific Inductive Power of Wires.—An Academy note of a theoretical character by Mr. Beaulard, is published in "L'Ind. Elec.," August 10.

Mechanism of Conduction.—"La Lum. Elec," August 4, publishes an article of some length by Mr. Blondin, based on the article of Mr. Burton in the "Phil. Mag." for July.

Work of Hertz.—In a note by Dr. Lodge in the Lond. "Elec.," July 27, he regards as the special discovery of Hertz the transmission of electric waves in free space; their transmission along wires was noticed by Von Bezold in 1870 and by Lodge in 1887.

Elliptically Polarized Electric Radiation.—A note by Dr. Lodge is contained in the Lond. "Elec.," August 3.

Equation of Discharge.—An Academy note by Mr. Swyngedauw, is published in "L' Ind. Elec.," August 10.

MAGNETISM.

Heating of Magnet Coils.—In a short article by Mr. Mueller in the "Zeit. feur Elek.," June 15, he gives a table of the current density in the wire, the rise of temperature after five hours and the percentage increase of speed necessary to keep the difference of the potential constant; the results were obtained by experiment from a coil containing 21 layers of 2.5 m. wire; experiments with coils of wire of other sizes showed a difference of only 1 to 2 per cent., and he therefore concludes that the table which he gives can be used for a wide range.

Forces in Magnetic Circuits.—The Lond. "Elec. Rev.," August 10, notices a paper by Prof. Threlfall in the "Phil. Mag." for July, recommending it as an important paper to those who have occasion to design reciprocating electro-magnetic mechanisms. The same paper is abstracted at some length in "La Lum. Elec.," July 28; the theory of Maxwell that the magnetic forces are due to the ether tension is discussed.

The Law of the Magnetism of Iron.—In "L'Ind. Elec.," August 10, Mr. Gulmann discusses Froelich's recent paper (see Digest August 4), in which he claims to have found the law; Mr. Culman showed that this law gives very incorrect results for high degrees of magnetization; for values of H above 385 the results differ more and more from those obtained by experiment; he compares the calculated values with those obtained by several experimenters.

Terrestrial Magnetism.—Prof. Rucker's presidential address to a section of the British Association is published, apparently in full, in the Lond. "Elec.," and "Elec. Eng," August 10, and is devoted almost entirely to terrestrial magnetism.

Magnetic Perturbation.—An Academy note by Mr. Monreaux describing a recent very large perturbation, is published in "L'Ind. Elec.," August 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Magnetic Qualities of Iron.—A letter from Dr. Koepsel regarding his instrument, mentioned in the Digest, July 28, is published and discussed editorially in the Lond. "Elec.," July 27; he states that the suggestion to make it a torsional reading instrument would not do away with the compensation windings, as these do not neutralize the effect of the movable coil, which is practically nothing; they are intended to neutralize the magnetic effect of the fixed magnetizing coil, thus measuring $\mathcal{B}$ alone, instead of $\mathcal{B} + \mathcal{H}$, a torsional apparatus would not have the advantages of a direct reading instrument. (The apparatus was mentioned in the Digest, May 12. and described under another name in "The Electrical World," Feruary 24, page 236.)

Instrument for Measuring Permeability—"La Lum. Elec.," July 28, gives a short illustrated description of the apparatus of Knapp & Sprong. It consists essentially of a horseshoe magnet, and a peculiarly shaped pivoted armature between its poles attached to a pointer and moving against the action of a deflecting spring; the instrument is applied by placing the two poles on the piece of iron to be measured, stops being provided to keep the distance from the magnet to the iron the same; the iron therefore magnetically shunts the armature and the diminution in the deflection of the pointer is therefore an indication of the permeability of the iron, the sale having been calibrated empiracally.

Testing Thermometers.—According to the Lond. "Elec. Rev.," July 27, the method used at Owens College, with which much greater accuracy is obtained, consists in heating the bath containing the thermometers by means of another bath surrounding it, in which the heat is generated by a coil of platinum wire.

Photometry.—The first of Captain Abney's Cantor lectures, abstracted in the Digest April 28 and May 12, is published in abstract with illustrations, in the Lond. "Elec., Eng.," July 27.

Government Calibrating Laboratory.—The laws and rules regarding the new department which has just been established by the Austrian Government for the calibration of electric meters, are published in the "Zeit. feur Elek.," August 1.

International Ohm.—The Lond. "Elec. Rev.," August 3, calls attention to the fact that the ordinary forms of the Wheatstone bridges can be made to measure the ohm,as adopted at present,by the simple expedient of adjusting the coils in one of the ratio arms, so that instead of having equal values, they have values in proportion of the former ohm and the new ohm.

Capillary Electrometer.—An inprovement by Mr. Gouy, intended to make the instrument more precise and easier to use, is described in "La Lum. Elec.," August 4. (An improvement was described in Digest, May 12).

DYNAMOS AND MOTORS.

Elementary Theory of the Induction of the Alternating Motor.—Mr. Kennedy begins a series of articles in the Lond. "Elec. Rev.," August 10; the theory is borne out by actual facts and includes no mathematics. Discussing first single-phase motors, he uses, as an illustration, an Arago copper disk, revolving in front of two alternating electro-magnets; he shows that the rotation is caused by the action of the inducing and the induced currents on one another, and that it depends on the lag between these two currents; such a motor must be started before it will rotate by its own action; he shows how it can be started by placing semi-circular copper disks between the rotating disk and the poles, the copper pieces thus screening off half the poles; after the motor is started these copper poles may be removed.

Sine Curve Alternator.—"La Lum. Elec.," July 28, in referring to the large alternator of the General Electric Company, in which it is claimed that the currents are perfectly sinusoidal, considering this of too little importance, and asks what they will be after having been "filtered" by the transformers.

Increasing a Dynamo Current.—According to the "Zeit. feur Elek.," July 15, Mr. Burnowsky proposes to wind a ring armature with the three windings,each with a commutator; the current from a few cells is led into the inner winding; when the armatures revolve poles will be formed, which induce currents in the second winding and part of these pass to the third winding, thus "producing an increased magnetic field,"which in turn increases the current in the armature.

TRANSFORMERS.

Current Rushes in Transformers.—Mr. Hay's serial is concluded in the Lond. "Elec.," August 10; he states that the phenomena is a very frequent and general one and that cases in which there is no distortion are the exception with moderately high degrees of magnetic induction, from 2000 C. G. S. units upwards, as used in modern transformers. the initial state of the iron very materially influences the amount of the rush; it has been stated that current rushes do not occur at high periodicities, but in his experiments the frequency was rather high, namely, 122; under ordinary conditions, with more or less slow acting switch, current rushes may be reduced to a large extent, by increasing the fre-

quency. In conclusion he describes, with the aid of some illustrations. the special switching arrangement which he used in his experiments.

Transformer Systems.—A correspondent to the Lond. "Elec. Rev.," and "Elec. Eng.," August 10, points out that the automatic switch in the Lowrie system (see Digest last week) which is the main feature in the system, is not likely to work at all, and he suggests that a simple working experiment be made.

Transformers.—The translation of the German article by Mr. Korda, mentioned in the Digest, July 21, is given in abstract in "La Lum. Elec.," August 4.

ARC AND INCANDESCENT LIGHTS.

Decorative Use of Incandescent Lamps.—The Lond. "Elec.," July 27, abstracts a short article from a forthcoming work of Dr. Fleming on "Electric Lamps and Electric Lighting." He shows the importance of concealing the source of light itself, on the ground that the illuminating power of light for the purpose of vision does not depend merely on the candle-power of the lamp but on the amount of light which is received by the eye from the surfaces from which it is reflected; the area of the pupil of the eye varies from about one 150th to one 10th part of a square inch, and if exposed to bright lights it may contract so much that the effective illumination of objects is diminished; although lamp globes of frosted glass may cut off from 30 to 50 per cent.of light, the actual visual effect may.in spite of this,be increased. The proper method is to place the incandescent lamp so that no light from the filament can enter the eye directly, and that it shall reach it only after reflection from the surfaces of the various objects in the room. Bare and uncovered lamps, especially if suspended half-way down or slightly above the level of the eye, form an exceedingly disagreeable method of illumination and ought never to be permitted in any cases where a decorative effect is desired; a natural shell forms a very effective screen and reflecting surface, especially if slightly translucent. A second important principle is to distribute the light properly and to prevent its concentration in large masses, thereby avoiding the production of harsh shadows; a simple test of the effectiveness of the distribution is to hold a white sheet of paper horizontally above the level of the eyes and a pencil vertically to it; if any marked shadows are produced the light is sufficiently diffused and the lamps should be rearranged. The third guiding principle is to proportion the light to the nature of the surfaces from which it is reflected; dull walls reflect only about 20 per cent., light tints of wall paper or paint may reflect from 40 to 60 per cent, clean white surfaces, as varnished wood or plaster, may reflect as much as 80 per cent. and mirrors from 80 to 90 per cent.; he gives the table of Dr. Sumpner, published in the Digest, March 4, 1893 (see also "The Electrical World" March 18, page 205). Rooms with dark woodwork, dark paintings, hangings, curtains, etc.,may require from two to three watts per square foot of floor surface, while one with very light decorations, water-color paintings, mirrors, etc., about three quarters of one watt may be assumed, the lamps being supposed to be about 8 or 9 feet above the floor; these figures however, cannot be taken too absolutely; as a broad general rule, 100 square feet of floor surface will be barely illuminated by 16 c. p. lamp 8 feet above the floor, well illuminated by two such lamps and brilliantly illuminated by four, on the assumption that the lamp is 8 feet above the floor and that the floor surface is fairly reflective. (For articles on similar subjects see Digest, July 15, '93, Guy; September 23, '93, Preece; April 15, '93 and the article on lighting," August 11, '94).

Lighting.—A translation of the article abstracted in the Digest, August 11, is published in the Lond. "Elec. Rev.," August 10.

Mensing Arc Lamp.—This lamp is described in the Lond. "Elec. Rev.," August 10; it is based on the action of a band brake; the lamp is simple, short, compact and cheap and can be used for alternating currents.

ELECTRICAL RAILWAYS.

High Speed Railroading.—Under the heading "The Boynton Bicycle Railroad," the Lond. "Elec. Rev." discusses this system and high speeding railroading in general; regarding the Boynton system, it believes that there is lack of novelty in the invention, that the cost of the superstructure will probably be very high and that it is beset with the same insuperable difficulties as other schemes in the rounding of curves; it can see no difference between this system and that of Mr. Danchell, which was tried in 1883. Extracts are made from Sabine's tables regarding air resistance, in which he thinks that the resistance of a vertical flat surface is proportional to its area and the square of the speed; with 150 miles an hour his table gives about 40 horse-power per square foot; Smeaton's rule gives 45 h. p.; it is claimed by some that at high velocities the resistance becomes practically constant, which is thought to be borne out by experiments on trains in actual service; notwithstanding this it believes that it is not easy to obtain 150 miles an hour; some apparent errors in the description of the Boynton system are pointed out.

Accumulator Traction.—According to "La Lum. Elec.," August 4, the experience in Paris has shown the cost of electric traction to be 10.6 cts. per car-kilometer and that of animal traction 11.2 cts. per car-kilometer; this does not seem to include repairs; on the accumulator line, the traffic, the speed and the comfort of the passengers were greater and the stoppages were made more quickly.

Heilmann Locomotive.—The French railroad company which is experimenting with the Heilmann locomotive, has, according to "L'Ind. Elec.," August 10, ordered two new locomotives embodying improvements and modifications; they will have Willians engines of 1,500 h. p. each; it is expected that the tests will take place in May of next year.

Submarine Navigation.—The Lond. "Elec. Rev.," in an editorial in the issue of August 10, states that the future of submarine navigation lies in the hands of electrical engineers; compressed air is not suitable on account of the excessive weight of the reservoirs and on account of the great cold produced during expansion; it adds that no system of electric accumulator has yet been discovered, which is perfectly adapted to the needs of submarine navigation.

Liverpool and South London Railways.—Some comparative figures for the Liverpool Overhead and the City and South London Underground railways are given in the Lond. "Elec." August 3; the "loco" expenses per train mile,not including salaries and wages for repairing work, were 5.5 and 11.5 cts. per train mile respectively.

South Staffordshire Railway.—The working results, together with some comparative statements of the cost per car mile for running and repairs of this and several other roads in England, are given in the Lond. "Elec. Eng.," July 27.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Train Lighting.—In the "Elek. Zeit.," August 2, Mr. Brunn gives a very complete description, with illustrations, of the system which is being used at present on some express trains in Denmark. Experiments were tried some time ago during a period of nine months, and as they were so successful the present more extended plant has been installed for making further tests; the conditions are favorable, as the lighting is only during four hours and the trains are at the stations for 8 or 10 hours during the day; in order that a car may be removed without extinguishing the light, the train is provided with a double system of wiring and a battery in the first and last car; the car wiring and some of the details are illustrated. In the detailed estimates of the cost, which are chiefly of local interest, an allowance of 30 per cent. has been made for maintenance, amortisation and interest on the accumulators, and 10 per cent. for the rest of the installation, not including the replacing of the lamps; the estimated total cost of operation is about one-third (.38) of the total cost; the total cost of operation per candle per hour is given as 0.154 cents. No definite figures are given for comparing these with the cost of the gas lighting formerly used, but it is stated that the costs of the electric lighting are certainly not greater than those of gas lighting, in which the gas is obtained from oils, and that probably it will be found to be cheaper.

London.—The Lond. "Elec.," August 10, announces that the London Electric Supply Corporation (using the Ferranti 10,000 volt system) has passed into the hands of a receiver; $4,250,000 were sunk in this undertaking.

WIRES, WIRING AND CONDUITS.

Spans of Soft Copper Wire.—In an article by Mr. Herzog in the "Elek. Zeit.," August 9, he discusses theoretically the various factors and relations entering into the calculation of the stretching of soft copper wires between poles for overhead lamps. He deduces a very simple method for calculating the various factors graphically; the diagram consists of sets of curves on cross-section paper giving the relations between the temperature of the wire, the distance between the points of support, the sag and the specific tension, that is, the tension per square millimeter of cross-section; by means of this table any one of the factors can be found directly when the others are given. (The table is in meters, centigrade degrees, kilograms and square millimeters, but it can readily be converted into the units used in this country, without redrawing all the curves, by simply inserting the equivalents of the various figures on the table itself. In the form given the table seems to be a very useful one and it facilitates calculations very greatly.)

Mains.—The Lond. "Elec. Rev.," August 10, in an editorial, suggests that the vexed question of the most suitable system of mains for electric lighting should be thoroughly threshed out by a parliamentary commission; it appears to argue in favor of vulcanized rubber.

Armored Flexible Conductor.—An illustrated description of a double conductor is given in "Ind. & Iron," July 27.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Automatic Telephone Switchboard.—The automatic system of Mr. Nissl, in which each subscriber can call any of the others (see Digest, June 2), is described at some length in the "Elek. Zeit.," August 9, and in the "Zeit. feur Elek.," June 15; the description includes a large complete diagram of the connections.

Morse Relays as Telephones.—According to the "Zeit. feur Elek.," August 1, it was noticed that under certain circumstances the Morse relays, which were connected in the telephone circuit,acted as telephones; speech was distinctly audible, especially if the ear was placed on the table on which the relay was secured.

The Lebedinsky system is briefly described in the "Zeit. feur Elek.," August 1; by means of it a train while at rest may communicate with a station by connection with the lines running along the road; the system is to be introduced on a Russian railway.

Telegraphing and Telephoning Over the Same Line.—In the "Elek,

Zeit.," August 2, Mr. Christiani describes, with the aid of some good diagrammatic cuts, a complete system for telegraphing and telephoning over the same line, but apparently not simultaneously, in which none but the Morse and telephone apparatus at present in use in Germany, are required.

Telephone vs. Telegraph.—According to the Lond. "Elec.," July 27, the English post office authorities are introducing telephones for telegraph purposes all over the country.

Telephone in France.—Comparative statistics of the years 1889 and 1894, are given briefly in "L 'Elec.," July 21. (This covers the period during which the Government controlled the telephones.)

Indicating the Departure of Trains.—An apparatus for indicating the departure of trains from stations is described and illustrated in "L 'Elec.," August 4.

Lightning Arrester for Telephone Circuits.—Mr. Engelmann, in the "Elek. Zeit.," gives an illustrated description of a new form of sawtooth lightning arrester.

ELECTRO-CHEMISTRY.

Purification of Water.—The Villon system is described briefly in the Lond. "Elec Rev.," August 10; nitrate of soda is added in quantities equal to the magnesium and calcium salts in the water; a current is passed between lead electrodes, which forms precipitates which quickly settles; no traces of the reagents remains in the water; about 250 litres an be purified in one hour in the experimental plant; the most extensive experiments refer to the treatment of 20 cubic-meters per day at the cost of one per cent. per cubic meter.

Manufacture of Oxygen and Hydrogen.—A process for the commercia manufacture of oxygen and hydrogen, with the aid of electrolysis, by Prof. Latschinow, is described at some length in the "Zeit. feur Elek.," June 15, July 1 and July 15; it includes a number of illustrations of the apparatus.

Electrolysis of Sulphate of Copper.—An Academy note by Mr. Chassy regarding the nature of the deposit under various conditions, is published in the 'L'Ind. Elec.," August 10.

Electro-deposition of Iron.—"La Lum. Elec.," July 28, contains some data and receipts.

MISCELLANEOUS.

Magnetic Clutches and Brakes.—The article on "Magnetic Chain-Towing" abstracted in the Digest last week, is concluded in "La Lum Elec.,' July 28. Applications of magnetic adherence apparatus to traction canals and to friction clutches, are given, including the illustration of the latter which was published in the Digest March 11, 1893; some tables of tests with magnetic brakes are given, and it is estimated that an expenditure of 40 watts per brake at 80 volts would suffice for the greatest braking effort that would be required for the heaviest cars or the fastest trains, on the basis of a single brake for each shaft. Experiments show that a friction clutch about 2 ft. mean diameter at 200 revolutions will transmit 80 h. p. with a current of 0.6 amperes for the brake (the voltage is not given); in another case a steel clutch, 6 ins. mean diameter at 600 revolutions, transmitted 48 h. p. with an expenditure of 225 watts.

Crane.—An electric overhead traveling crane, devised by Messrs. Bollinex, is described and illustrated in the Lond. "Elec. Eng.," August 3. Continuous current and a separate motor for each movement, are used.

Modern Telephone Exchange Practice.

BY J. E. KEELYN.

An evolution in telephone practice is prospective, and the improved system for telephone service for the immediate future will undoubtedly be a radical one from the system which is now in vogue. The new and independent telephone companies will be in the position of adopting all the innovations that come up, and naturally they will not be slow to take advantage of them.

The most important feature of telephone practice, the feature that concerns alik e the electrical fraternity, the telephone exchange investor, and the subscriber, is that of charging for service, and it is well known that the present plan of charges is unsatisfactory alike to the operating company and the subscriber.

In the first place the operating company is interested in getting the greatest amount of revenue from the smallest investment and simplest s rvice. At present, in the use and abuse of telephones, the subscriber is the exception and the non-subscriber the rule. It costs the subscriber no more to allow the free use of his telephone by the non subscriber, and although it is a slight nuisance, the non-subscriber is permitted its free use (clandestinely, perhaps), entailing an expense for extra service on the exchange. To overcome this a changed system of charges must obtain.

The new method will undoubtedly be one by which a first and fix d charge, at a nominal rate, representing a proportioned profit upon the first cost of plant, will be made per telephone. Then an increased charge will be made per additional amount of service required by the subscriber; to illustrate, a flat rate of say $12 per annum per telephone and one cent per call for service. If the subscriber is charged for each call made at his telephone, it will soon become generally known to the public, and the subscriber will be the rule and the non-subscriber the exception, reversing the present order of things. Thus non-subscribers, who take advantage of present conditions, would find it costs as much to use their neighbor's telephone as it would to have one, and the exchange would realize payment for all service rendered.

The new devices for registering the calls made on a telephone are as efficient as a gas or electric meter, and will keep the necessary record, so that there need be no dispute between the exchange and the subscriber when time for settlement comes.

One of the new features of modern telephony will be public toll stations *ad libitum*, where the public may drop in its penny, use the telephone and not annoy private subscribers. It may not be too much to assert that within a very short period such toll stations will be found to pay in nearly every block in the central portions, and every few blocks in the outlying districts of the principal cities.

When the non-subscriber is made to furnish his share of the maintenance of a telephone system, it is easy to see that the rentals alone will be reduced one half or more. It will also extend and increase the number of telephones without so greatly increasing the maximum amount of service. Further, it would bring the subscriber within the range of quick service, which is an important element. For instance, if John Smith has a telephone, his next door neighbor, Thomas Brown, makes use of it. When some subscriber in the system desires Brown, he calls Smith, and te time absorbed in sending for Brown is unnecessarily wasted and calls upon the line are responded to by the reply "busy." The nuisance of "busy" telephones is too well known to need elaboration here.

Now that magneto and non-infringing telephones are a decided success, the features I have pointed out, together with many others which will make themselves prominent in the near future, will occupy the earnest attention of telephone men, and will result in material changes for the better of telephone practice.

The Western Electric Railway Company Enters the Railway Field.

The growth of the electric railway in this country during the past two or three years has been so rapid and extensive that it may justly be considered the most important part of the electrical field to-day. The latest comer in this promising field is the Western Electric Co., of New York and Chicago, which has decided to enter the railway supply trade and to carry in stock a full line of everything necessary both in the construction and operation of electric railways. The company will carry a large variety of types of railway material, among which may be mentioned the standard cap and cone and West End types of overhead material, of a high grade of insulation and made of the very best gun metal. The company will also handle everything necessary for overhead equipment, as well as tools, wire, car and station fittings, testing instruments, etc., so as to be able to fill any order for railway work. In addition to this the company will carry a line of repair parts of motors, controllers, etc., and will rewind armatures and refill commutators. In fact it intends to supply a railway construction company or a railway in operation with anything in the railway and supply line.

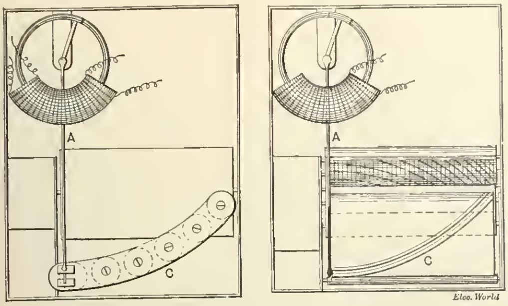
The Western Electric Co. is also bringing out a line of overhead material which is a modification of the West End type, retaining, it is claimed, all the good points of the West End hanger while at the same time it is much lighter, more symmetrical and more economical. A section insulator and insulated cross-over are also among the new goods that the company has in preparation. The facilities of the Western Electric Co. for handling electrical goods of all descriptions is well known and its reputation in the electrical field is so firmly established that it will enter upon railway work with every assurance of success.

Recording Meter.

The question of measuring and recording an electric current flowing in a circuit has long been appreciated as one of the most interesting and important problems in the electrical field. The approximate and summary results heretofore obtainable cannot be satisfactory to all interested parties, for it is not enough that a consumer of electric current be told that during a certain period he has received so many watts or amperes hours; he wants a first proof of the correctness of such a statement, and further, he wants to know under what conditions he has received the current, so as to enable him to judge what use he has had from the same. The electro-metallurgist, for instance, if he needs 100 amperes at 2-volt tension cannot be satisfied if he receives 2 amperes at 100 volt tension, nor can a consumer of electric light be satisfied with 60 volts when he needs 120, yet any such consumer has up to the present been obliged to pay for all energy whether it was useful to him or not. It is, thus evident that the only satisfactory instrument for measuring electricity, must be the one which not only gives a lasting, permanent record of the amount of current that has passed through a circuit per unit of time, but also indicates under what conditions said current passed.

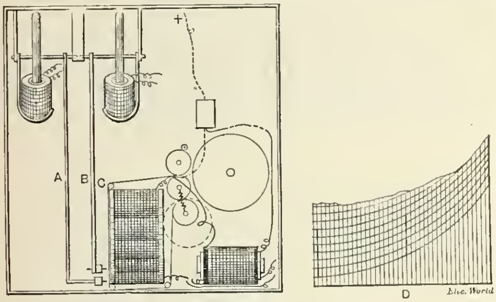
A patent has been recently granted to Mr. J. W. Th. Olan for an instrument of this kind, of which we give an illustration. It consists principally, as shown in Figs. 1, 2, 3 and 4, of a record sheet D, moved by a time mechanism, which, as it passes the support plate, C' is marked upon

by the two pointers, D and D' these pointers, which are moving in correlative arcs over said plate and sheets, are governed respectively by variations of the tension and quantity of the current, and in this way a continuous, permanent and correlative record is made of the tension, as well as the quantity of the current for a certain period of time. The



FIGS. 1 AND 2.

sheets may afterwards be used as an undeniable and corroborating evidence for justly regulating the accounts between the supply companies and the consumer. The Swedish-American Engineering & Art Co.,

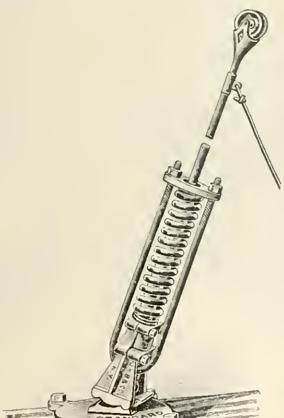


FIGS. 3 AND 4.

a concern formed for carrying on general engineering business and promoting inventions, has secured the control of the Olan Recorder

Standard Trolley and Trolley Wheel.

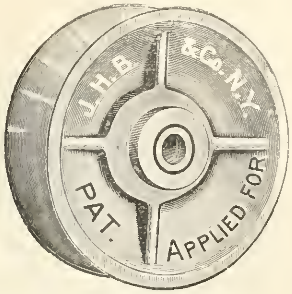
The trolley and wheel shown in the accompanying illustration have recently been placed on the market by J. H. Bunnell & Co., 76 Cort-



BUNNELL TROLLEY.

landt Street, New York City. The trolley has few parts, is simple, light and strong. A positive contact is secured at any angle from a horizontal position to perpendicular, which renders the trolley of special value for use in car barns and under bridges and other places where the trolley wire is often unusually low. It has quick action, preventing its jumping from the wire at frogs, crossings, etc.

The wheel is made of the highest grade bronze, and is very durable. Special care is taken in its composition to insure long life and yet relieve

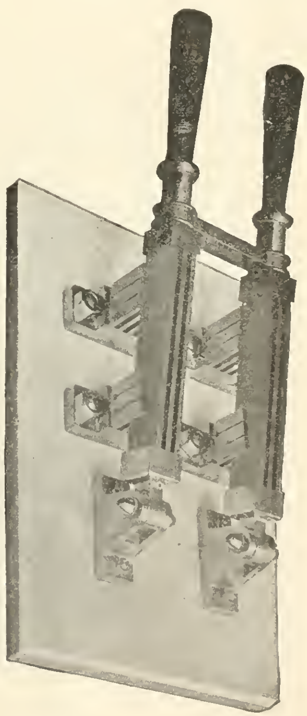


BUNNELL TROLLEY WHEEL.

the trolley wire from all unnecessary wear and tear. It is made in the best form for wear and has a high conductivity. It is fitted with the best quality of graphite bushing, and is adapted to the standard trolley fork.

Large Capacity Switch.

The accompanying illustration shows a new style of switch for work requiring a large carrying capacity, which has been recently introduced by J. Grant High & Co., 123 North Third street, Philadelphia. A novel feature of this switch is the construction of the blades and jaws. The former, as will be noted in the illustration, are made up of sections,



LARGE CAPACITY SWITCH.

thus allowing means of perfect contact and ventilation, and at the same time avoiding the usual bulky appearance of switches of the same carrying capacity. The jaws are specially designed to form a perfect contact by being made in sections longitudinally and divided transversely. This style of switch is made in sizes ranging from 700 to 10,000 amperes

Mechanically Operated Bells.

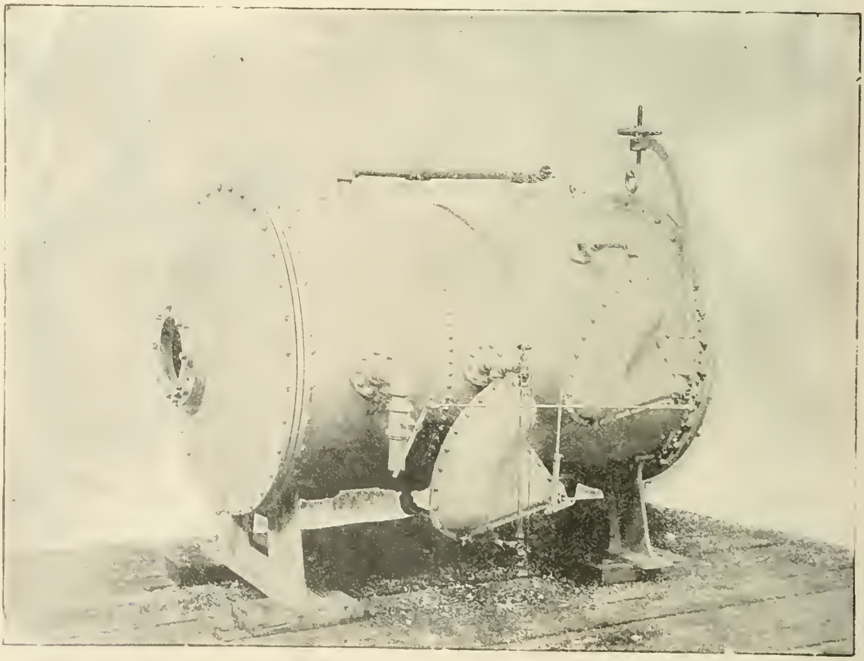
In the type of bell illustrated herewith, invented by N. J. Busby, 8 Bedford street, Boston, the advantages claimed are that there is no breaking of circuits or grounding of wires or bother with batteries in any way. They are more sensitive to touch than electrical bells and are always safe and reliable, and when once in place all expense ceases.

MECHANICAL DOOR BELL.

They give the long electrical ring and are worked with either a push button or a pull knob, and are applied on the centre or side casing of a door or at any required distance away. They are also worked from the floor by a foot push under the table, or where most desirable to locate such a push to call servants from any part of a house.

Heater, Purifier and Receiver.

The apparatus illustrated has been expressly designed by the Stillwell-Bierce and Smith-Vaile Co., Dayton, O., to meet the requirements of architects and engineers, in connection with the steam-heating of large buildings. By its means cylinder oil is removed from the exhaust steam before it enters the feed water heater. There is a large area of removable shelves, which serves the double purpose of heating the feed water and depositing the scale-producing salts; there is also a very large space for holding heated-feed water and returns, which are both absolutely and automatically controlled.



HEATER, PURIFIER AND RECEIVER.

Electricity in Mining.

An interesting installation has recently been made by the General Electric Co. in a silver mine in the South, in which electrical apparatus plays a very important part. The generating plant, situated at the mouth of the mine, consists of two engines 10½ and 16x12. These are connected through friction clutches to a common shaft carrying a band wheel, and each engine operates one D-62 General Electric generator of 500 volts potential and 85 horse-power output.

The power-house also contains a separate "9x9" McIntosh & Seymour high pressure engine, operating an arc dynamo of 18 lights capacity and a 150-light incandescent dynamo. The pulley upon the common shaft is to be used to operate a third D-62 generator as soon as the extensions in the mine warrant the addition, while a 500-light alternating plant, which is also to be installed, will be run from a separate engine and will supply light for a town about two miles distant.

The current is carried from the power-house to the tunnel of the mine and the various shafts over insulated copper wires. At shaft No. 1, 1,000 yards from the mouth of the mine, two hoists have been installed, one of the single type operated by a 16 h. p. motor, the other of the double reel type, a description of which is given below. At a distance of about a mile from the station is shaft No. 3, which is equipped with a 25 h. p. single drum hoist. Shaft No. 1 still retains its steam hoist and is provided with a small direct connected plant of the marine type.

The large electric double reel flat rope hoist is probably the largest ever made, and has just been completed by the General Electric Co. It nominally works in balance and has a capacity on each side of 5,000 pounds, the mean speed of the rope being 500 feet per minute. The motive power is furnished by a General Electric 125 h. p. motor of the L. W. P.-20 type, similar in size to the large ones used to propel the cars of the Intramural Railway. The lower frame of this motor is provided with feet, which allow of it being bolted to the bed plate of the hoist. The maximum demand on the motor will be about 80 h. p. when the hoist is working singly. Under normal conditions, that is, when it is hoisting in balance, the demand will be about 50 h. p.

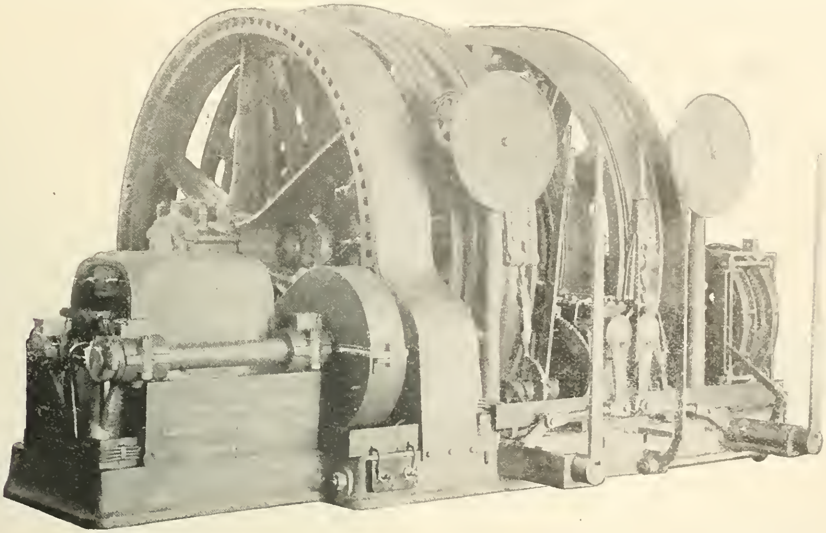
The hoist itself is extremely compact; the dimension of the base, exclusive of the motor, is 9¼ feet square, the width being increased by about 3 feet 4 inches by the addition of the motor. The height is about 7¼ feet above the foundations, the reels, however, extending a little below the level of the bed plate. The reel centres are 4 feet apart, and have a capacity each of 1,000 feet of flat rope. The diameter of the naked reel is 3 feet; this, when wound with the rope, is increased to eight feet. On account of the direct relation between the working diameter of the reel and the weight of the rope unwound, which forms a consider-

able part of the load, the work done by the motor remains practically constant.

When the load is started from the bottom of the mine, the weight of the rope, about 2,500 pounds, is added, but it is being wound on an 18-inch radius. When the load nears the top only the ore and the skip are being lifted and the winding radius has increased to 48 inches. The average speed of the intermediate shaft is 200 revolutions per minute, which gives a starting speed at the bottom of the mine of 400 feet per minute and at the top 600 feet. The regulation is therefore automatic.

The entire weight lifted from the bottom is about 5,500 pounds—2,000 pounds of ore, 1,000 pounds of skip and 2,500 pounds of rope. The reels are loose on the shaft, the hubs having brass bushings which may be readily renewed when worn. To each reel is cast on the side a polished clutch ring 5 feet in diameter, and upon this is fitted a Webster, Camp & Lane band friction clutch, the ring being keyed upon the shaft. This clutch is of improved type, and forms one of the special features of this hoist. By its means the load may be started at any point without jerking; or the load may be released and allowed to come to rest when the hoist is running at full speed. The clutch has wooden faces which can easily be replaced when worn.

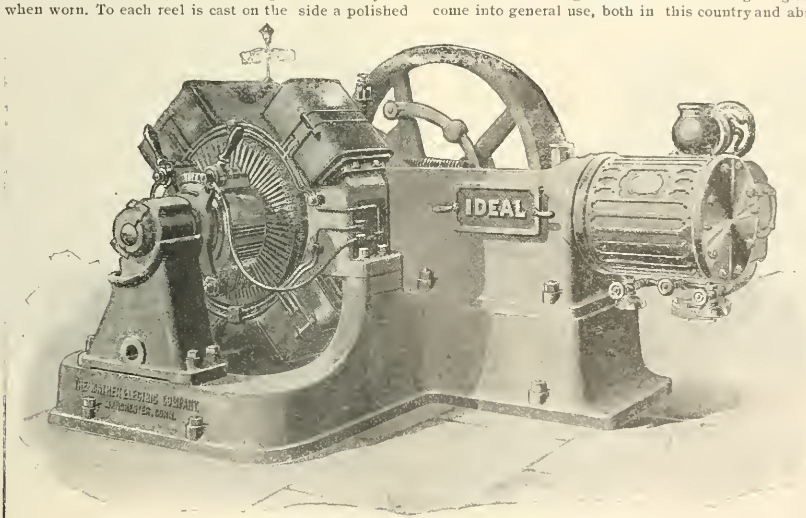
The brake rings are keyed to the reel and are 7 feet 6 inches in diameter, with an 8¼ inch face. Each is designed to allow for expansion of the brake when lowering, which heat may bring about. The reel shaft is of steel 6 inches in diameter, the journals being increased to 8 inches at the centre, and run in bearings babbitted and adjustable. The indicators on the front show the position of the cages. The weight of the hoist complete is about 3,200 pounds, and no part is so large but that it can be lowered into a mine, the tunnel of which is 7 feet by 8 feet.



ELECTRIC MINE HOIST.

Direct-Connected Generators.

Direct-connected generators for electric lighting and power plants have come into general use, both in this country and abroad, and are conceded by the leading electrical engineers and architects as being the most efficient in both theory and actual use. Briefly, the advantages of the direct-connected apparatus are: First, economy in floor space, this advantage being especially appreciated where the generator is in crowded or limited quarters; second, the absence of noise in the operation of the plant, whic follows from the absence of all belting, etc.; third, economy in operation over a belt plant, which is considerable at all times, but especialy so where the load is of an intermittent nature or where the plant is not operatin at its full capacity at all times; fourth, extreme sim-



DIRECT-CONNECTED MULTIPOLAR GENERATOR.

plicity and minimum requirement of attention, and long life of apparatus on account of slow speed in operation.

The illustration herewith shows a 100 kw. Mather multipolar generator, of which type a description appeared in our issue of August 11, direct coupled to a 150 h. p. Ideal engine. These generators, which are manufactured by the Mather Electric Co., Manchester, Conn., are designed to be directly connected to any first-class type of engine adapted for this work, and are exceedingly compact. They are self oiling, self exciting, self-regulating, and, after being started, require no attention. They are compound wound and entirely self-regulating, and equally well adapted for electric lighting, electric railway, or power purposes.

Trolley Harp and Wheel.

We illustrate herewith a trolley harp and wheel which has been recently put on the market by the Hubley Manufacturing Co., Lancaster, Pa., which has been designed after the most careful study of the conditions which this important element of the car equipment has to meet. The crescent section of the side bars adds strength to lightness, and affords a rounded surface which will not catch or dent the trolley wire. They are shaped to give ample room or the edges of the wheel and perfect protection to the contact springs. The pin is fastened by an improved method, giving a large bearing and avoiding sharp corners.

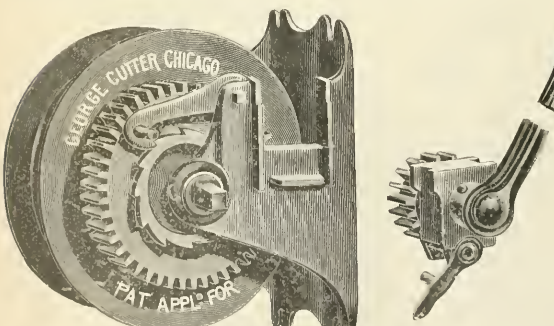
TROLLEY HARP AND WHEEL.

The metal is so distributed in the body that the wheel may be entirely worn out, while the wire can never be worn by coming in contact with the harp, which is one of the greatest faults of the usual forms of harps. The wheel is designed to give a greater amount of service than any yet produced, which result is obtained by using the highest grade of bearing bronze, and in the proper distribution of the metal. Many of these wheels are still in service after making the phenomenal record of 10,000 miles.

Combination Windlass.

The geared windlasses familiar to arc lamp users have two disadvantages, one being the high cost, due largely to the fitting of the pinion and gear, the other the loss of time in lowering lamps, as the gearing is generally needed only for the raising. George Cutter, of the "Rookery," Chicago, in bringing out the new form of windlass shown in the illustrations, has kept these points in view. This is called a combination windlass, because it can be used either as a plain or as a geared device, at the trimmer's discretion.

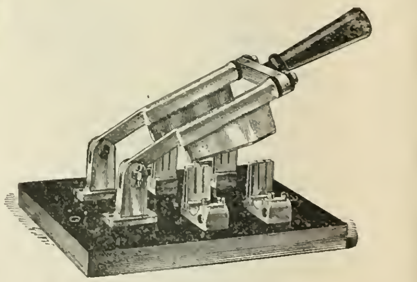
The windlass proper has a strong frame, with the back curved to fit the pole, the slots for the supporting bolts being so planned that the device can be quickly put up. The handle shown in the cut is rigidly secured to a small pinion mounted in a light bearing, which is so shaped as to fit into a recess in the windlass frame. By slipping this into place and locking it with the hinged cam, the pinion is brought into gear with the hoisting drum, thus giving three times the ordinary leverage. The pinion handle with these fittings is still quite light so as to be easily carried by the trimmer, and as only one of these is needed for several dozen windlasses, there is quite a saving over the cost of windlasses with fixed gears. The details are carefully worked out and the whole lo k ke a very practical device.



ARC LIGHT HOIST.

A New Knife Switch.

The accompanying illustration shows a double pole, double break switch recently placed on the market by Taylor & Clark, 510 Arch street, Philadelphia, Pa. It is simple in construction, strong and durable, quick in action, and of unusually neat finish. All the contact blades are sweated in and riveted and carefully finished, so that good contact is insured. The insulation is carefully rounded off, and the workmanship throughout the switch is of such a standard as to give it a very attractive appearance. The screws upon which the knife swings are tapped only on the end so that a smooth rotation surface is secured. In all sizes above 60 amperes a quick break device is used. These switches are made in all styles and sizes, from 15 to 1,000 ampers.



THE "T & C" KNIFE SWITCH.

A New Incandescent Arc Lamp.

The arc lamp we illustrate, made by the Manhattan General Construction Company, 50 Broadway, New York, contains a number of new features and is claimed to present the advantages of fewness of working parts, economy in trimming and carbons, an enclosing globe acting as a spark arrester and preventing insects from collecting within, susceptibility to artistic designs, regularity in feed, a positive cutting out action, and capable of burning singly with economy on incandescent circuits.

To embody these features in one lamp, a radical departure from prevailing types was necessary, and an inspection of the general appearance and detail of construction will show a bold handling of the problem.

Only one form of construction satisfied all requirements, and that was to have the mechanism concentric to the central stem; magnet, armature, clutch mechanism, cut-out, carbon-holding frame and globes. In outside lamps the main-line circuit runs through a switch in the cap and the lamp may be removed and the circuit left to pass uninterrupted. The wires enter the cap through inclined insulated openings which exclude the weather. To shorten the lamp, the customary carbon rod has been dispensed with and a thin sheath or holder feeding through the clutch rings with the bare carbons substituted. A cushioned clutch feed is provided, which gives a smooth and imperceptible feed, without the characteristic jumps of arc lamps.

The most important feature of the lamp is the enclosed globes. The outer globe is air tight at all points except at the bottom, where there is a hand-hole large enough to permit of cleaning and trimming the lamp, which is yieldingly closed by a detachable dust-pan. This prevents the oxidation of carbons, and makes it practical to trim the lamp without disturbing any air-tight bearings. The upper opening of the outer globe is secured to the carbon frame and there made air-tight by asbestos gaskets, the globe and frame screwing into the body of the lamp.

Within this enclosing globe and immediately surrounding the arc, is a smaller globe into which the carbons are fed, there being, however, no air-tight bearings. The outer globe is a storage for the products of combustion, or diluting chamber, thus preventing access of air containing oxygen to the carbon points. On the formation of an arc the enclosed air is heated, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to carbon monoxide, and this, with the remaining nitrogen, surrounds the arc and protects the points from further combustion.

By this system of burning of carbons in enclosed chambers, half-inch carbons will burn eighty hours without retrimming, and without

any blackening or discoloration of the globe. Owing to the high potential at which it is possible to burn the arc in the enclosing chamber, the efficiency of the lamp is greatly increased.

The lower part of carbon frame is in the shape of a ring having a diametrical enlargement to admit the arms of a spider-shaped casting, and which is provided with an adjustable movement on the carbon holder. This carbon holder has a porcelain handle and a spring to hold the yielding pan tightly against the lower opening of the globe. A longitudinal bore in the carbon holder admits the negative carbon, the upper part of the bore being enlarged to form a seat for the small globe. A metal cover, through which the positive carbon loosely feeds, is placed over the mouth of the small globe and acts as a cut-out when the carbon has been burned to a predetermined point.

For inside lamps a rheostat of enameled iron is provided in the shape of a head-board with binding posts, hanging straps and switch complete. An opening in the centre of the rheostat permits of securing it to the ceiling by half-inch lag screws. Porcelain insulators, placed over four studs provided for that purpose, may be used to separate the rheostat from contact with the ceiling. When not desirable to secure the rheostat directly to a ceiling, the lamp may be suspended from a ring.

As carbons are only consumed at about the rate of one inch in eight

NEW TYPE OF ARC LAMP.

hours, it will be seen that the lamp seldom feeds, so that, aside from the feature of the sneak feed provided in the lamp, carbons are only required to change positions about one-tenth as often as in a lamp which burns in the open air, and are, consequently, much more steady and regular in burning.

The Johnston Rail Bond.

The value of a good return circuit in electric railway work is now becoming to be recognized as a necessity, not only to obviate the injurious effects of electrolysis on neighboring pipes, but also as a matter of economy. That the former is now a real danger is acknowledged by many who fomerly regarded the matter as one of relative unimportance, and the more recent literature on the subject shows that with time the most serious damage may be done. As a consequence, if the matter of providing a proper return, which in most cases may be secured by good bonding, is not attended to by street railway companies, they will sooner or later meet with interference from municipal authorities which will be far from agreeable.

From a direct economic standpoint the matter is of even greater importance. A resistance through imperfect bonding of a tenth of an ohm on a ten-car line may amount to a loss of energy as high as 13 horse-power, and as deterioration will be constant, rebonding at greatly increased cost will finally be required.

The rail bond which we illustrate, manufactured by the Car Equipment Co., 741 Drexel Building Philadelphia, is claimed to obviate all trouble from defective and insufficient bonding, and is the result of seven years' experience and experimenting on the part of the inventor., Mr. A. Langstaff Johnson. Owing to the contact afforded by the hole in the web of the rail, and also the side of the rail against which the bond nuts are jammed or drawn up, the area of contact is twelve times the area of the wire, thus enabling the maximum conductive capacity of the track to be utilized. This bond being thus much superior to rivets, channel pins or any other bond now in use, a track can be laid with

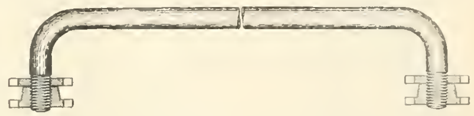


FIG. 2.—JOHNSTON RAIL BOND.

the assurance that it need never be disturbed to inspect the bonds, for the contact afforded is durable, being almost indestructible. The size of the wire with this bond can be varied and thus, for instance, as the power-house is approached where the flow of current is heaviest, the bond-wire may be increased to any size in order to provide for the accumulation of current on that part of the line; this can be done without altering the bond-nut at all, but merly by tapping it sufficiently to take the size of the wire desired.

The bond is secured to the rail by means of two nuts, shown in Fig. 1, which are applied to the ends of the bond, as shown in Fig. 2. The

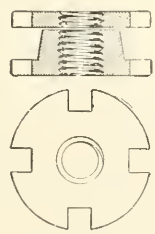


FIG. 1.—NUTS OF BOND.

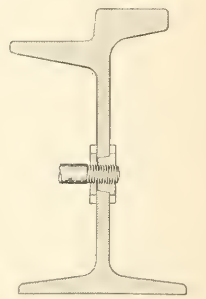


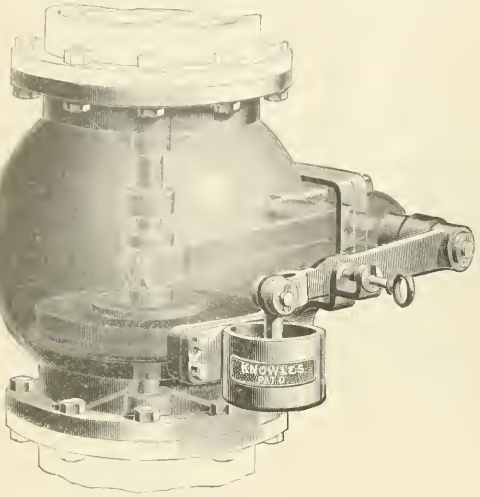
FIG. 3.—THE BOND APPLIED.

web of the rail is perforated by a taper hole, and after the insertion of the bond the nuts are screwed up tight, forcing the tapered nut into the nut, as shown in Fig. 3. In order to make the contact as perfect as possible, the rail is faced on each side immediately surrounding the hole in the web where the bond nuts come in contact with it, for which purpose a special tool has been designed, which enables this work to be done accurately and expeditiously. The hole in the web of the rail is punched in the usual way and then bevelled by a counter borer, which is furnished for the purpose.

Automatic Exhaust Relief Valve.

The accompanying illustration of the Knowles automatic relief valve, manufactured by the Knowles Steam Pump Works, 93 Liberty street, New York, shows this valve to such good advantage that a minute description of it is hardly necessary. The valve is for use on the exhaust pipe of condensing engines, especially those whose stoppage or even slowing up would entail serious consequences, such as engines for electric power and lighting purposes. The valve, which stands in a vertical position, opens automatically in case of any accident to the air pump, or a lack of injection water that would cause a loss of vacuum in the condenser. The valve proper is made of a material that will withstand the heat of the steam, and is made to fit air tight upon a composition seat. The vertical motion of the valve is limited by a collar on the spindle, the latter being guided above and below the valve. One of the principal features of this valve is the dash pot, which is shown bolted to the side of the chamber. The dash pot cylinder contains a piston connected by levers to the main valve, and moves simultaneously with it. As it is necessary for the valve to open promptly, air is admitted under the piston dash pot through a small valve, opening inwards, placed in the bottom of the cylinder. This allows of a quick upward motion, giving instant relief to the accumulated pressure in the exhaust pipe, and allowing the engine to run non-condensing. As soon as the vacuum in the condenser is again

obtained, the atmospheric pressure tends to seat the valve. By this action the air under the dash pot piston is compressed, closing the small inlet valve, and slowly escapes between the cylinder and piston and allows the main valve to noiselessly seat itself without shock or jar. When the engine is to be run non-condensing, a special arrangement is



Automatic Exhaust Relief Valve.

applied, as shown, to hold the valve open and allow the exhaust steam to pass directly into the atmosphere. These valves are made in various sizes to suit different requirements.

Electric Door Opener.

The electric door opener we illustrate, now being placed on the market by J. Jones & Son, 67 Cortlandt street, New York, will, it is claimed, require only a small battery power to operate it, even against an unusual pressure. The mechanism is simple and efficient, the locking device consisting of a specially shaped pivoted part controlled by a bent spring, and the movement of the magnet armature to release this part being very small. The finish and workmanship are of the best quality.

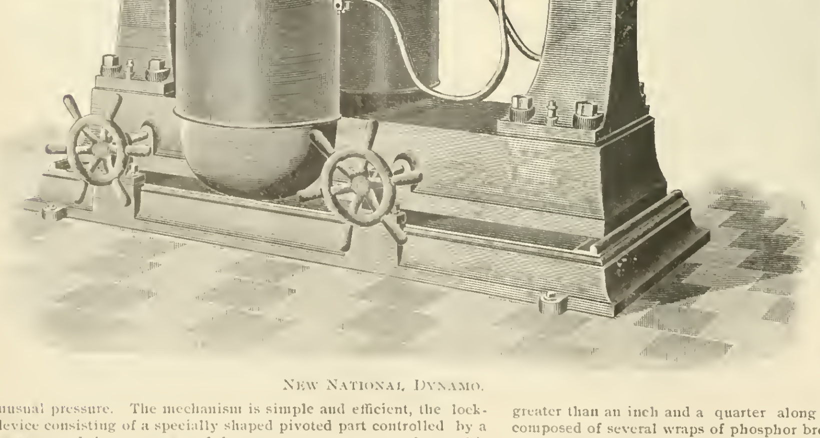
New National Dynamo.

The over-type bi-polar dynamo was originally adopted as a standard at the National Factory, Eau Claire, Wis., and the experience of several years has confirmed the opinion that for all capacities up to as high as sixty kilowatts it is unrivalled as a commercially successful type. This form has therefore been adhered to when the new National Electric Company undertook the design of a complete new line of dynamos and motors, and we illustrate the 50 kw. machine.

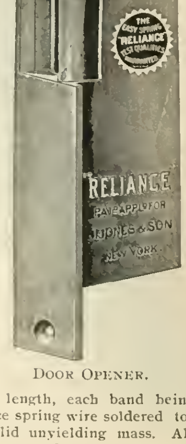
Referring first to the purely mechanical features, it will be observed that the machine is compact and substantial looking, with regular outlines. It is mounted upon a heavy cast-iron base, and is provided with convenient and easily operated shifting screws for tightening the driving belt. The base and bearing supports are made of liberal proportions, so as to be entirely unyielding. The bearings of the machine are of the ring, self-oiling type, and are self-aligning; the bearing sleeve is provided with a spherical surface which rests in a seat of corresponding form in the pedestal, constituting thereby a ball and socket combination, which makes it impossible for the bearings to get out of line. The armature shaft, of ample size to secure stiffness as well as strength, is turned from a high grade of forged steel, which insures good wearing qualities.

The armature is adjusted to perfect rotative balance, and runs free from straining actions. It is also balanced magnetically in a longitudinal direction, being held in the proper position by the action of the field without the use of collars on the shaft. The action is similar to that of a spring which allows a slight elastic end-play, yet resists undue displacement. The field magnet has rounded, easy outlines and is massive in form. By the use of a powerful field, by giving the pole pieces the proper form and bore by providing ample brush surface, the most satisfactory results have been obtained in smooth and sparkless operation. The machines will take care of themselves, and will not require shifting of the brushes for each variation of the load.

By massing the metal uniformly in the magnetic circuit by using wrought-iron cores, and carefully determining the proper field windings, a field of maximum strength is obtained with a minimum of exciting current. The efficiency is further promoted by properly constructing the armature core and arranging the winding with a view to reducing armature losses. Durability of the machine parts is assured by the thoroughness of the construction and long life for the insulation is secured by the absence of that high degree of heat incident to the operation of many dynamos. The armature is of the standard drum type. The cores are built up of thin steel disks, insulated, keyed to the shaft, and clamped rigidly in position. There are no less than five layers of selected insulating materials—including oil-paper, linen, ducking, mica, etc.—between the core and conductors. The entire winding is stayed and wedged with fibre strips, and it is firmly banded at intervals not greater than an inch and a quarter along its length, each band being composed of several wraps of phosphor bronze spring wire soldered together; thus, the winding constitutes a solid unyielding mass. All parts of the machine are made to standard guages and templates, and are interchangeable.



New National Dynamo.



Door Opener.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 25, 1894.

GENERAL ELECTRIC has, as always in times of activity, been the foremost of the electrical stocks. It has at various times during the financial week, occupied a conspicuous position in the stock market dealings, the trading in it being marked by a sincerity that evidenced the presence of genuine buying orders. It has been very strong. The buying has emenated from the best inside sources, from people who have become acquainted with the company's uninterrupted progress towards complete rehabilitation. Work on the equipment contracted for by the Chicago elevated railroads is being pushed well along. The company is also paying particular attention to the designing and construction of suburban railway motors of a heavier pattern than those now in use on the more extended lines in the city limits. There is also now in experimental use at Schenectady a 110-ton electric locomotive built for the Baltimore & Ohio Railroad Company, and soon to be used by them in their new terminals at Baltimore. Some 3,000 men are now employed at Schenectady and about 2,000 operatives are at work in the Lynn shops, where none but the light work is now being done. At present the company has orders in the railway department alone for 61 generators and 8 of these are ponderous machines.

FORT WAYNE ELECTRIC matters continue to engross attention. President McDonald avers that the present business policy is a complete success, but declines to declare himself relative to the announcement that the General Electric is infringing on railway patents secured by the Ft. Wayne Electric corporation in this week's purchase of the Wenstrom Electric Company of Baltimore, capital $1,000,000. The corporation invites subscriptions from the old stockholders for its 6 per cent. gold debenture bonds at 90 per cent., and interest. According to the official circular, subscribers are to pay 10 per cent. of the amount in cash at the time of subscription to the American Loan and Trust Company, 40 per cent. in cash in 30 days thereafter and at the same time the remaining 50 per cent. of their subscription in trust receipts for stock of the Ft. Wayne Electric Company's stock now deposited with State Street Safe and Deposit Company at $5 per share. This is in accordance with the reconstruction program recently promulgated.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES continues in its policy of retiring the preferred stock. This week it set aside $65,000 for this purpose, and secured from the many offerings made 658 shares, paying therefor an average price of $98.65 per share. This makes a total of 14,682 shares cancelled since the "trust" was formed last year, all the money being derived from dividends and interest payments on the stocks and bonds incorporated, or rather deposited in it. Besides this week's purchase of shares, the trustees have set aside another $66,000 to buy in preferred shares, proposals to be received until August 30. There are only 45,000 shares preferred stock altogether; deduct 14,682 already retired from the total issue, and there are left outstanding 30,318 shares. As they have been retired at an average rate of 2,000 shares a month since there has been any accumulation of profits it will only take fifteen months before the whole issue is retired, which will make the $4,500,000 common stock the sole owners of the $12,000,000 stocks and bonds acquired from the General Eectric last year for $4,250,000.

BELL TELEPHONE matters promise some interesting developments at an early date. President Hudson is expected home from Europe on the 14th of next month, and some determination of the company' financial policy relative to the issue of the $30,000,000 new capital stock authorized by the Massachusetts legislature will then be decided upon. This new stock, according to legislative restrictions, must be sold at public auction, but the company's officials do not yet know how much is to be issued at a time, nor whether they will agree at all to the present restrictions. There is still talk heard of a removal of offices to this state, and of getting the New York legislature to give permission to issue the new stock at par.

WESTERN UNION TELEGRAPH stock continues to hold its quotation at 89 to 89¼ with great steadiness, reflecting merely the general strength of the stock market, as there has been at no time during the past week any decided movement in either direction. Bull points in great profusion are, however, being distributed on the Stock Exchange, and predictions are freely made that the stock will sell at 95 or upwards in the near future. Present earnings are understood to be on a basis that assures a continuation of present dividends, August business being declared to be nearly 20 per cent. ahead of that done in July. There is, moreover, a large short interest extant, and, if this should once be scared into an attempt to cover, some lively scrambling to buy will be witnessed, as the supply of floating stock is not very large.

WESTINGHOUSE ELECTRIC continues quiet. The company is bending all its energies toward getting into the new works at Brinton, near Pittsburg, and the officials have all they can do to attend to strictly business matters, letting Stock Exchange quotations take care of themselves. Quotations, however, continue well held.

EDISON ELECTRIC ILLUMINATING OF NEW YORK. The company's returns so far for August indicate that the net earnings this month will show the same ratio of increase that has been made in previous months. New York Stock Exchange statistics show that the illuminating company's net earnings have increased 300 per cent. in six years. The net earnings for 1894 are now estimated to be easily $750,000.

INTERIOR CONDUIT AND INSULATION COMPANY report to be now steadily earning 8 per cent. The company's record shows an increase in net earnings of 1892 over 1891 of 33 per cent., the same rate of increase for 1893, while the first six months of 1894 shows an increase of 25 per cent. The stock is almost entirely held by the officials of the company.

AMERICAN DISTRICT TELEGRAPH COMPANY. It is now thought that when the directors meet early in September a quarterly dividend of 1 per cent. will be paid. This company is rather unsteady in its dividend rates. Last year it paid 3 per cent. per annum.

THE NIAGARA FALLS POWER COMPANY has increased its capital stock from $2,600,000 to $3,000,000. At the meeting Secretary Rankine of the Cataract Construction Company, represented the New York interests and the vote was favorable to the increase, at the rate of 40,000 shares at a par value of $10 a share.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	98½	100
* " " " Brooklyn	100	101	105
* " " " Boston	100	120	121
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	3	3¼
General Electric	100	42¼	44
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	33	34
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	1,000	109	110
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	200	201
*American District Telegraph	100	40	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
*Erie Telephone	—	45¾	46
Gold & Stock Telegraph	100	100	102
*Mexican Telegraph	100	190	200
*New England Telephone	—	68	69
*Western Union Telegraph	100	89⅛	89¼

*Ex. div.

NEW INCORPORATIONS.

THE TROJAN TELEGRAPH COMPANY, Troy, N. Y., capital stock $5,000, has been formed.

THE PONTIAC TELEPHONE COMPANY, Pontiac, Ill., capital stock $3,000, has been incorporated.

THE SEASHORE ELECTRIC LIGHT & POWER COMPANY, Asbury Park, N. J., capital stock $100,000, has been incorporated.

THE AMERICAN FRICTION MOTOR COMPANY, East St. Louis, Ill., capital stock $2,000,000, has been incorporated by W. B. Wolcott and others.

THE TAYLORSVILLE MILLING & MERCANTILE COMPANY, Taylorsville, Ky., capital stock $25,000, has been incorporated by W. P. Beard and others, to establish an electric light plant.

THE MERCANTILE CARBON COMPANY, New York, capital stock $50,000, has been formed to manufacture a new arc lamp. A. C. Seiboia, Mt. Vernon; Harry Hoyt and S. M. Comstock, New York, are interested.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Pensacola, Fla., capital stock $20,000, has been formed to operate an electric light and power plant. T. E. Welles, S. C. Cobb, C. J. Heinberg, Pensacola, are interested.

THE NEWPORT HEAT AND POWER COMPANY, Newport, Pa., capital stock, $1,000, has been incorporated to supply electricity for light, heat and power purposes. The promoters are J. H. Irwin, W. H. Gautt and H. Beard, all of Newport.

THE VISCOSITY OIL COMPANY, Chicago, Ill., capital stock $10,000, has been formed to manufacture and deal in general steam and electric supplies and lubricating oils and greases. S. A. Johnson, Wm. H. Little and J. H. Poage are the promoters.

THE FACTORYVILLE LIGHT, HEAT AND POWER COMPANY, Factoryville, Pa., capital stock $7,000, has been formed to supply light, heat and power by electricity. C. A. Sisk, W. N. Manchester, S. Reynolds, all of that town, are interested.

THE NICHOLSON LIGHT, HEAT AND POWER COMPANY, Nicholson, Pa., capital stock $7,000, has been incorporated to supply electricity for light, heat and power. The promoters are C. A. Sisk, Factoryville; F. N. Boyle and H. D. Tiffany, of Nicholson, Pa.

THE CAMDEN POWER & LIGHT COMPANY, Camden, Ark., capital stock $10,000, has been formed to purchase, own and operate electric plants and to upply light and motive power to the public. C. L. Vickers, W. K. Ramsey, and J. S. Cumming are the promoters.

THE MONARCH ENGINE-STOP COMPANY, New York, maximum capital stock $250,000, has been formed to manufacture, buy and sell steam, electrical and other machinery, etc. L. W. Sweet and J. Livingston, New York, and C. A. Benton, Riverdale, N. Y., are the promoters.

THE SCOTT ELECTRIC LAMP COMPANY, New York, capital stock $25,000, has been formed to manufacture and sell lamps and other electric apparatus R Outcault, New York; B. H Herbert, Hoboken, N. J., and Palmer Brown Woonsocket, R. I., are the interested parties.

THE ACME ELECTRIC COMPANY, St. Louis, Mo., capital stock $5,000, has been formed, to manufacture and deal in electrical supplies and apparatus of all kinds and to do a general electrical business. E. T Goodberlet, J. A. Goodberlet, L. E. Goodberlet, St. Louis, Mo., are interested.

THE CENTRAL BELL TELEPHONE COMPANY OF VENEZUELA, Chicago, Ill., capital stock $400,000, has been formed to construct, own and operate telephones, and to supply electric light and power for various purposes. The promoters are J. K. Myers, A Amerman and T. J. Fell.

THE ZIEGLER ELECTRIC COMPANY, Boston, Mass., capital stock, $25,000, has been formed to manufacture and sell electrical and mechanical instruments, machinery, and apparatus. A. A. Ziegler, A. Ziegler, J. O. Ziegler, J. L. Gebhardt, Geo. Sauer, 72 Federal street, Boston, Mass., are the organizers.

THE LOCKPORT CITY & OLCOTT ELECTRIC RAILROAD COMPANY, Lockport, N. Y., capital stock $200,000, has been formed to operate an electric

trolley railroad from Lockport to Olcott, a distance of twenty miles. W. T. Holt, W. D. Gaillard, A. G. Funck, J. L. Toon, M. E. Stone, and E. J. Cunningham, New York, are the interested parties.

THE ROBERTSON INSULATED CONDUIT ELECTRIC COMPANY OF CHICAGO, Chicago, Ill., capital stock $1,000,000, has been formed to make and sell inventions, improvements and patents in electric railway appliances and devices, etc., and to equip and operate street, horse and dummy railways in Chicago. J. L. Murphy, S. B. Bracey, H. B. McMillan, B. W. Sherman, W. O. Osgood and C. A. Dye are the incorporators.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, August 25, 1894.

MR. F. C. BATES left for Europe on the Kaiser Wilhelm August 18, to take a position with the Union Elektricitats of Berlin. He goes over there permanently, and will be employed principally on electric railway work. Mr. Bates is well known having been connected with the Thomson-Houston Company for three years, at Lynn, Mass., where he had practical experience in electric construction. He has recently been connected with the firm of Charles H. Warner, 50 Broadway, and with him was resident engineer for the Brigantine Transit Company, in constructing a railroad at Brigantine Beach.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, August 25, 1894.

MR. A. B FIELD, for a long time connection with the Thomson-Houston and later with the General Electric Company, being one of their most energetic salesman at the present time, traveling for them in the Eastern States, will on Sept, 1 identify himself with the Iona Manufacturing Company, and will be pleased to see all his old friends at 336 Congress St-, Boston.

THE ELECTRIC APPLIANCE COMPANY, of Providence, R. I., has just completed and has ready for the market a very elegant and extensive line of ornamental flush plate pushes and gas lighting keys. The patterns are elaborate designs in filigree and scrolls, standing in relief, finished in antique copper and brass and modern etruscan, bronze, etc. The Company is doing a driving business filling sample orders for their goods, and promises the trade several other new and agreeable surprises in the very near future..

W. H. BOWDLEAR & COMPANY, 36 Central Wharf Boston, is one among the oldest firms engaged in the manufacture of material for insulating purposes, although because of its extreme conservatism it may not be as generally known as some of its competitors. Notwithstanding this fact, however, it does an excellent business with the electrical trade. "Ozokerite," one of its insulating specialties, is attracting considerable favor. Its strong qualities are pliability, waterproof, moisture proof and odorless properties.

THE IONA MANUFACTURING COMPANY, of Boston, has been kept busy straight along, notwithstanding the summer months and business depression, and in order to meet the constantly increasing demand for its specialties in the line of sockets, switches, cut-outs, etc., additional floor space in its factory has been leased. Mr. Norman Marshall, manager of the company, who believes thoroughly in hard work, and he has been most active in pushing its business, anticipates a considerably larger business this fall than ever heretofore.

THE HANDBOOK entitled "Standard Wiring," for electric light and power, by H. C. Cushing, Jr., electrical inspector for the Boston Board of Fire Underwriters, which will be out of press in a few days, is designed to fill the long felt want of central station men, contractors and constructing engineers. It not only gives all the latest rules formulæ and tables for alternating and direc current wiring, but also contains twenty full-page illustrations of outside and inside construction as approved by the fire underwriters throughout the United States, as well as the International Insurance Association. Mr. Cushing is booking already some very large orders for it.

Pittsburg Notes.

Pittsburg, Pa., August 25, 1894.

THE SECOND AVENUE TRACTION COMPANY has completed its main line from Braddock to Turtle Creek, which gives the company a direct line of electric railway from Pittsburg to Turtle Creek, a distance of 13 miles.

MR. THOS. I. TRACY, secretary and treasurer of the Electric Appliance Company, Chicago, who is spending his vacation in the East, reports that the Western indications of improvement and a good fall trade are good.

A FIRE broke out last Monday night in the laboratory of the Westinghouse Electric and Manufacturing Company, but apart from a scorching to the furniture and the walls, as well as the loss of some experimental apparatus, the damage was very slight. The fire did not interfere with the operation of the works.

MR. LEON LE PONTOIS, of the draughting department of the Westinghouse Company, was married last Tuesday to Miss Eleanor O. Reed. After the nuptial knot had been tied, the young married pair went on a trip to the southeastern shore of the Atlantic. Mr. Le Pontois is well known in Pittsburg as a lecturer on electrical subjects.

THE SECOND AVENUE TRACTION COMPANY is about to erect a new power house for the operation of its entire lines. The plant will be put up at Glenwood. The contracts for the buildings, the engines, the boilers and the entire electrical equipment have already been let. The Russell Engine Company has secured the contract for the engines, and the generators, amounting to a capacity of 1,800-h. p., will all be furnished by the Westinghouse Electric and Manufacturing Company.

THE MEMBERS OF THE G. A. R. next month will hold their annual encampment in this city, and one of the most interesting features of entertainment provided here for the "boys in blue" will be a grand banquet and reception at the new works of the Westinghouse Electric and Manufacturing Company in Brinton, Pa., near this city. The immense size of these buildings makes them especially suitable for the purpose. At the present time there are about 1,000 workmen occupied in the buildings, getting them in shape for the occasion. Floors are being laid, tables are being put up and seats are being erected. The affair will perhaps be one of the largest receptions that has ever been held anywhere, and it is only owing to the coincidence that the encampment and the completion of these large buildings happens at the same time that this reception is made possible. How many thousands of people will be there cannot be foretold, but arrangements are being made to have 5,000 people sit down to the table at one time. The reception will be held in Machinery Hall, which is a structure 754 feet long and 254 wide. The building will be lighted by 240 arc lghts.

Western Notes.

THE CHICAGO GENERAL FIXTURE COMPANY, in addition to its splendid line of electric and combination fixtures, now handles a complete line of electrical supplies.

J. HOLTGATES, one of the busiest individuals in the electrical field, reports unusual success with Mather apparatus and Card street railway motors. Mr. Gates is still in the Monadnock, and is always busy.

THE CHICAGO CROSS ARM COMPANY, with an office at 932 Monadnock building, has made a very good impression with its cross arms made of Georgia pine, which, according to government tests, shows remarkable strength and durability.

THE UNION BRASS MANUFACTURING COMPANY, under the new management of Mr. A. Weinberg, has made decided progress in the introduction of the popular Mosher arc lamps. The new alternating current lamp manufactured by this company is meeting with remarkable success and is being rapidly introduced on alternating systems throughout the country.

THE KNAPP ELECTRICAL WORKS has surprised and pleased its host of friends and customers by issuing a catalogue that will find a place among the finest specimens of trade literature. As a catalogue of electrical goods it could not be improved upon. As a specimen of the printer's art, it is superb. It is well worth having just as a book, to say nothing of its many advantages to those wishing to have at hand a complete encyclopedia of standard electrical specialties and devices.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY last week added to their list of exchanges by equipping one at Cambridge, O., which is pronounced to be the finest telephone system of its extent in the state. One of their recent victories was at La Grange, Ill., where they secured a contract for the complete exchange, and still another is announced by telegraph at Decatur, Ind. The company have just arranged for a registering device which records every call made upon the exchange by the subscriber, which operates on the same lines electrically that gas meters operate mechanically. Its factory is running night and day to keep up with the flood of business that is now upon them.

THE HARRISON INTERNATIONAL TELEPHONE COMPANY, finding it impossible to conduct its business from the New York office, has opened another in the Chamber of Commerce building, Chicago. It has also organized branch companies in eighteen sections of the United States in order to give the business more direct supervision. The company builds plants complete, or electrical companies can purchase their telephones and appurtenances, and do their own construction. The automatic switch offered by this company is creating considerable attention. Manager Hanford is now nicely settled in his new office, and feels confident of an immediate as well as permanent success with the Harrison telephone.

THE WALLACE ELECTRIC COMPANY has added to its present line of specialtes a complete line of arc lamps adapted for almost every purpose. The company is now western agent for the Electric Construction and Supply Company, New York. The "Ward" arc lamps manufactured by this company need no introduction. The Wallace Company will carry a complete stock in Chicago, including alternating, direct current, double carbon and twin lamps, ornamental, plain, railway, search, theatrical and focusing lamps and projectors. The company's house goods department, recently inaugurated, is meeting with success, as that department has already made a record. The Eureka iron box manufactured by this company will be recognized in a new dress, and with its double adjustment features it is now one of the neatest and most serviceable bells on the market. The Ajax dry battery, the Diamond carbon battery, the Excelsior Disque La Clanche battery are all favorites. The company announces that its new illustrated pamphlet will soon be ready for distribution.

ARMOUR INSTITUTE, Chicago, has issued a prospectus of its course in the department of Electricity and Electrical Engineering, of which Prof. Wilber M. Stine, Ph. D., is director. This course extends over four years, and has been designed to be more distinctively electrical than is common with other electrical schools, and aims, by a most thorough training, both in theory and practice, in a great measure to bridge over the hiatus between the school on the one hand and the electrical factory, central station, or usual engineering practice, on the other. Due prominence is given to the idea that a thoroughly trained electrical engineer must be equally well grounded in mechanical and steam engineering and machine-shop practice. The degree to be conferred upon the completion of the full course in electricity is Bachelor of Science in Electrical Engineering. Upon the completion of an additional year of resident post-graduate electrical and mechanical study and testing, or after two years of actual engineering work, the degree of Electrical Engineer will be conferred.

News of the Week.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The Mobile & Spring Hill Railroad Company will improve its road.

HAZELTON, PA.—Southsiders want the trolley extended to Silver Brook Junction.

KEY WEST, FLA.—E. H. Gate has been granted a franchise to convert his street railway into an electrical road.

OXFORD, PA.—It is reported that a preliminary survey will soon be made for the proposed route of the Oxford & Parkesburg Electric Railway.

ASHLAND, MASS.—It is stated that workmen have commenced on the construction of the electric railroad between Ashland and Hopkinton.

KNOXVILLE, TENN.—J. F. Scott and associates have been granted a franchise by the City Council to construct and operate an electric railway.

COLUMBUS, GA.—The Columbus Railroad Company is negotiating for the equipment of its street car and belt, passenger and freight lines by electricity.

LITTLE ROCK, ARK.—Fuller & Moss and H. F. Auten have applied to the City Council for a franchise to build and operate a four-mile electric railway.

ATLANTA, GA.—The Atlanta Consolidated Street Railway Company is equipping its Decatur branch with electricity, and the line will very soon be in operation.

MIDDLETOWN, N. Y.—An electric railway will be built through Benton avenue by the Traction Company, who will begin work immediately to connect its tracks.

POTTSTOWN, PA.—The Pottstown Passenger Railway Company is contemplating the extension of its line from Stowe to the bridge crossing the P. & R. R. at Bramcota,

WHITE PLAINS, N. Y.—A new company is being organized, which proposes to build and operate a trolley road from the Hudson River through the villages of Long Island Sound.

TOWSON, MD.—The extension of the Towson branch of the City and Suburban Electric Railway Company from Towson to Lutherville, Texas and Cockeysville, is being urged.

MEDIA, PA.—At the meeting of the borough council permission was given the Delaware County & Philadelphia Electric Railway Company to lay tracks on Washington street as far east as Oliver.

BERLIN, CONN.—Work on the Berlin extension of the electric line will begin September 1. H. S. Tuttle, of Lynn, has made a preliminary survey of the proposed route. Bids for the contract will be received at once.

CAMDEN, N. J.—The Camden, Gloucester & Woodbury Electric Railway will be extended from its terminus, at Woodbury, to Pitman Grove, and, perhaps, to Glassboro and Clayton, taking in the towns of Mantua, Wenonah and Sewell.

PLAINFIELD, N. J.—It is reported that the Street Committee of the Common Council and the Plainfield Electric Street Railway have finally settled upon an agreement, and that the extensions to Dunellen and Netherwood will soon be under way.

PHILADELPHIA, PA.—The West Chester & Philadelphia Turnpike Company has procured a charter for an electric railway and trolley from Philadelphia to West Chester, via Newtown square, with a branch line from the latter point to Paoli.

CATOOSA SPRINGS, GA.—J. H. Warner will construct an electric railway from Catoosa Station, on the Western Atlantic Railroad, direct to Catoosa Springs. Surveys of the proposed new line have been made by Major Moe, of Chattanooga, Tenn.

OWING'S MILLS, MD.—A power house for the proposed Pikeville, Reister Town and Emory Grove Electric Railway Company is to be erected at Owing's Mills. John H. Hoffman, of Hagerstown, Md., is president of the company, and may be addressed for information.

REISTERSTOWN, MD.—A public meeting will be held to further the project of building the proposed electric railway from Reisterstown to Union Mills, the connecting link between the Baltimore and Gettysburg systems. Gov. Brown and Dr. J. W. Hering will address the meeting.

ST. AUGUSTINE, FLA.—The City Council has caused a hitch in the negotiations for the electric railway under contemplation there. The franchise has some arbitrary requirements as to which end the road shall be first constructed from, and these requirements the Council has not removed.

BOSTON, MASS.—The Newtonville & Watertown Street Railway Company asks that it may extend its tracks in that part of Boston called Brighton. It also asks for the right to erect the needed poles with overhead wires for the operation of its cars by electricity. Horace B. Parker is president.

MONTCLAIR, N. J.—It is rumored that within a short time a conference between the township committees of Bloomfield, Caldwell and Verona, and the town council of Montclair, will be held to discuss the question of establishing a trolley road, and to decide whether it would be advisable to grant a franchise.

CRAWFORDSVILLE, IND.—Upon the application of H. J. Clodfeller, A. N. Painter, of Alexandria, and V. C. Quick, of the same city, representing a company of Indiana capitalists, the Madison county commissioners granted a franchise for an electric line through this county. It will be known as the Indiana Gas-Belt Electric Line.

OSWEGO, N. Y.—At the Common Council meeting, the petition of Maitland E. Graves for a franchise and permission to build and maintain a street railway, with necessary switches and turnouts, in East Ninth street, or East Tenth street and along Mitchell street to St. Paul's cemetery, was referred to the Committee on Streets and the city attorney.

HACKENSACK, N. J.—The question of building a trolley line at Hackensack was informally considered by the local authorities at a recent meeting of the Improvement Commission. The matter came up on the presentation by Commissioner Eckerson of the plans and specifications under F. H. Chinnock, who agrees to build and equip a trolley system in the town.

DOYLESTOWN, PA.—The Bucks County Railway Company has been incorporated, the line of which will run through the principal streets of Doylestown, and from Doylestown to Centreville and Newtown. Capital, $100,000. Incorporators: F. Fenimore, S. Savids, W. Jenks, F. Marshall, S. Lynch, S. A. Hamilton and Robert C. Fulton, Philadelphia.

TAMAQUA, PA.—The Tamaqua & Pottsville Electric Railway Company, whose charters cover territory from Tamaqua to Pottsville, via Middleport, New Philadelphia and Port Carbon, has filed a declaration of its intention to extend its main line from Port Carbon to St. Clair, and thence to New Castle and Frankville and down to Maizeville, in the Mahanoy Valley.

POTTSVILLE, PA.—S. B. Edwards, solicitor of the Pottsville, St. Clair & Minersville Electric Railway, stated that the company will be ready to commence building its road immediately after the Borough Council shall have given it the right of way to occupy certain streets. The road is to be 10 miles long and there is a capital of $150,000 to back it. Wilbur S. Sadler, of Carlisle, is president.

EAST STROUDSBURG, PA.—The new electric railway from East Stroudsburg to Bushkill has let the contract for the rails, and proposals are asked for furnishing 40,000 chestnut ties. Should the East Stroudsburg council refuse to meet the company on a fair basis they will run into that place over the tracks of the Delaware, Lackawanna & Western Railroad, which has been offered them.

BRIDGETON, N. J.—The contract for building the power house of the South Jersey Traction Company, in South Bridgeton, has been awarded to the Cumberland Construction Company, who was the lowest bidder. The equipment will consist of two 150 h. p. Corliss engines, two 100-kw. generators, with necessary boilers, switchboards and appliances, and will cost nearly $30,000 in all.

CONSHOHOCKEN, PA.—The Conshohocken Railway Company has purchased the right of way from the Plymouth & Whitemarsh Turnpike Company over the whole length of the road from the Schuylkill River to Plymouth Meeting. Mr. Shopp said that the company intends to give out the contract immediately for the building of the line through Conshohocken, and would push it to completion.

AMBLER, PA.—The announcement is made that a syndicate of Philadelphia capitalists has secured control of the stock of the Chestnut Hill and Spring House Turnpike Company, and contemplates the construction of a trolley line over the turnpike from Chestnut Hill to Ambler. Another line that may be built in the near future is an extension of the Norristown and Conshocken trolley line to Ambler.

IOWA CITY, IA.—Messrs. Seevers, of the Muscatine Electric Railway, are contemplating building an electric car line in Iowa City, and probably will do so if negotiations now in progress reach a successful conclusion. The plan is to purchase the gas plant, for which $65,000 has been offered, and build ten miles of track, which they promise to have in operation in 60 days after the council has granted the franchise.

MIDDLETOWN, CONN.—Work is soon to begin on the proposed system of electric railroads. The representatives of the New England Construction Company, which is to build the roads, have had their engineers here, and the work of surveying the route has been commenced. The new road to Meriden, it is expected, will be built in the spring. The lines in this city will be completed by the early part of the spring.

MILWAUKEE, WIS.—At the meeting of the Common Council a resolution was adopted authorizing the commencement of negotiations for the purchase of the property of the Milwaukee Street Railway Company, which includes not only all the street railway lines in the city, but also the plants formerly controlled by the corporations known as the Badger Illuminating Company and the Edison Electric Light and Power Company.

NANTICOKE, PA.—The News Dealer is authority for the statement that a New York brokerage firm has issued prospectuses for the promotion of an electric railway company to operate between Nanticoke and Berwick. The intention is to extend the line to Nanticoke. The proprietors expect to bond the road for $1,500,000. The company expects to build 23 miles of road. The Johnsons, of Cleveland, are said to be back of the enterprise.

OREGON CITY, ORE.—The Council is considering the granting of a franchise to a company to build an electric railway along certain streets from the top of the bluff out to the city limits. A committee has practically agreed upon an ordinance which will be reported. This company, in which is included John Myers, of Portland, states that it intends to prosecute the work as fast as possible, beginning within a month after it secures the franchise.

ELKHART, IND.—A big mortgage has been filed by the Indiana Electric Railway Company to secure the payment of bonds of the company, which may be issued to the amount of $50,000 for the construction, extension and improvement of the lines of street railway in Elkhart and Goshen, and the intersuburban lines. The work will be rapidly prosecuted. It is estimated that the lines in the two cities will cost $10,000 per mile, and one-half that much outside of town.

ANNAPOLIS, MD.—A special meeting of the city council met to consider the granting of a franchise to the Annapolis, Brighton Beach & Bay Ridge Electric Railway, for the use of the streets of Annapolis. The proposed company was represented by Messrs. George T. Melvin and James R. Branshears, two of the incorporators. Nothing definite was settled, although the committee is favorable to granting the privilege when the company complies with all the requirements.

HARRISBURG, PA.—Preparations are being made by the Cumberland Valley Traction Company to begin work on the construction of the electric railway from Harrisburg to Carlisle via Mechanicsburg. J. W. Brown & Co., of Harrisburg, have been notified to prepare the iron work for the strengthening of the bridge. The track will be laid on Walnut street and then over the bridge. The road from Harrisburg to Mechanicsburg is now within sight and the prospects are bright for its construction.

PIKESVILLE, MD.—An electric line between Randallstown and this place is contemplated. A committee consisting of Edward S. W. Choate, Dr. Henry J.

Hobb and others, representing the directors of the Randallstown, Harrisonville and Granite Rapid Transit Company, called upon Jos. T. Floyd, agent in Baltimore of the Barrow Electric Railway system, and made the proposition that the Northern syndicate represented by Mr. Floyd, co-operate with the local people in the construction of the road. The proposition was accepted.

SAN FRANCISCO, CAL.—An electric road from Merced to the Yosemite is proposed. These surveys have been made and other details have been arranged. It will move passengers and freight. The length will be sixty-two miles, following the course of the Merced River much of the way. The power will be secured from a dam already constructed at Merced Falls. It is proposed to furnish power to Merced for electric lighting and manufacturing purposes. G. A. Walkup, at the Palace Hotel, San Francisco, is proprietor.

RED BANK, N. J.—The Monmouth Electric Traction Company has filed its certificate of incorporation in the office of clerk of Freehold. The incorporators are Wm. W Coniver, Daniel H. Applegate, Charles B. Parsons, J. Enright, Jr., Wm. T. Parker, R. Avery, J. W. Robinson and others. The capital stock is $300,000, and it is proposed to build and equip a street railroad from Red Bank to Long Branch and return. The central power plant will be located at Red Bank. In all probability this company will build a road between Red Bank and Seabright.

EAST MILTON, MASS.—A company is being formed at Milton for the purpose of constructing and operating an electric street railway between East Milton and Mattapan. The corporation will be known as the Milton & Boston Street Railway Company, and will have a capital stock of $50,000. The road will be four miles long and will connect at Mattapan with the Dedham Street Railway. The directors are A. A. Brackett, J. R. Lawrence, D. J. Brown, W. H. Rice, of Milton, and J. A. Duggan, T. H. McDonald, and W. P. Pinel, of Quincy. Another new line will be one to Nantasket Beach, over the line to Quincy Point, thence to Nantasket by the Quincy & Nantasket Steamboat line.

NIAGARA FALLS.—The Niagara Falls and Port Dalhousie Electric Railway Company are applying for a charter for the purpose of constructing and working a street railway from Niagara Falls to Port Dalhousie, and passing through the intervening municipalities of Stamford, Thorold, Merritton, St. Catherine and Grantham. The capital stock of the company is to consist of $300,000. The applicants for incorporation are: Lany Lundy, of Niagara Falls; William J. West, Niagara Falls; Jay Schooley, of Welland; Alexander Nelson, Thomas Home and James Pearson, Toronto, all of whom are to be the first directors of the company.

WEYMOUTH, MASS.—An electric railway from Shaw's Corner, East Weymouth, through Weymouth and East Braintree to the station of the N. Y., N. H. & Hartford Railroad at Braintree, is projected. A company is to be organized and active steps taken to secure franchises from the Weymouth and Braintree authorities. A large amount of stock has already been taken. Among those interested are the following: Representative John Kelley, of Braintree; Judge James H. Flint, of Weymouth; Francis Ambler, F. L. King, E. W. Hunt, J. F. Sheppard, F. A. Sulis, H. F. Perry, C. T. Bailey and J. W. Carey. The road will probably be running by the last of October.

Electric Light and Power.

NEWTON FALLS, O.—A movement is on foot to establish an electric light plant.

PORT ARTHUR, CAN. The electric light plant of the town was destroyed by fire.

CROWLEY, LA. Address the Mayor concerning the electric light plant to be constructed.

OXFORD, MISS.—Address E. O. Davison concerning a proposed electric light plant.

SAN DIEGO, CAL.—Address the Mayor concerning an electric light plant to be constructed.

ALLEGAN, MICH.—The citizens have under consideration the question of municipal lighting.

LOCKHART, TEX.—The Lockhart Electric Light Company is about to build an electric light plant.

HENDERSON, MINN.—Address the Mayor regarding contract for establishing an electric light plant.

WESTFIELD, MASS.—The W. Warren Thread Works is in the market for a 250-light electric light plant.

LANCASTER, O.—Address C. D. Hills regarding an electric lighting plant for the Boys' Industrial School.

TOPEKA, KAN.—Address H. W. Farnsworth concerning an electric light plant for the High School building.

ALEXANDRIA, LA.—A. B. Rachol, acting mayor of Alexandria, will advertise for bids for an electric light plant.

OTSEGO, MICH.—George C. and B. E. Nevins are to establish an electric light plant, and are in the market for its equipment.

HOT SPRINGS, ARK.—The Hot Springs Electric Light Company is contemplating putting in a 1,500 lt. alternating machine.

PHILADELPHIA, PA.—Alterations, embracing an electric light plant, to cost about $50,000, are to be made to the Continental Hotel.

NEW ORLEANS, LA. R. L. Schroeder will give information regarding the electric light plant to be installed at the Government Mint.

OXFORD, MISS.—Address the secretary of the Young Men's Business League concerning the establishment of an electric plant contemplated.

INDEPENDENCE, ORE. The Independence Water & Electric Light Company has been succeeded by the Gilmore Electric Light & Power Company, incorporated.

Personal Notes.

MR. PHILIP DAWSON, of London, England, is on a visit of inspection to the United States with a special view of examining into American methods of street railway equipment and working, of which he will furnish an account in the columns of London "Engineering." Mr. Dawson was formerly associated with the late A. Reckenzaun, and more recently, as a partner, has been with Mr. R. W. Blackwell, 39 Victoria street, London, formerly president of the Buckley-Knight Company, in this country, and a brother of F. O. Blackwell, of the General Electric Company, and of J. L. Blackwell, consulting engineer, of Baltimore. The firm, in addition to its consulting work, has the sale of various electrical specialties, more especially for electric railway work, and has sold most of the railway material thus far used in England, and a considerable quantity on the Continent.

MR. J. W. OLAN, the subject of this sketch, whose name is familiar to the electrical profession through his contributions to discussions in the Transactions of the American Institute of Electrical Engineers, was born in Sweden. After four years of training at the Elementary State School and seven years spent in classical studies, he was graduated from the Superior College at Gothenburg, and entered in 1875 the philosophical faculty of the University of Upsala. Pursuing studies in mathematics, natural sciences and languages, Mr. Olan later went to the south of Europe and attended courses at the universities in Geneva, Paris, and various other places. Returning to Sweden he finished his studies at the Polytechnicum, in Stockholm, and adopted mining engineering as a profession. He took an active part in the installation of the Swedish section of the International Electrical Exhibition in Paris, 1881, during which year he entered into Edison's service and worked at the International Electrical Exhibition in London, 1881-1882. After a contract with the Edison Foreign Electric Light Co., Mr. Olan went, in 1882, to Sweden as superintending electrical engineer to undertake the pioneer work for the incandescent light in that country, and remained there until the Edison patent was annulled by the Swedish Government. Mr. Olan came to the United States in 1890, and has devoted the last several years to inventions, one of the most recent of which, the Olan Recorder, we describe elsewhere in this issue.

J. W. OLAN.

Trade and Industrial Notes.

THE BROWN & SHARPE MANUFACTURING CO., and DARLING, BROWN & SHARPE, Providence, R. I., resumed work in all departments of their establishments at the close of their annual vacation, Monday, August 20.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, O., has arranged its course in advanced mathematics so that it now includes algebra and geometry, trigonometry, analytical geometry and differential and integral calculus.

THE WATERTOWN ENGINE COMPANY, Watertown, N. Y, has at present as large a force engaged upon electric light engines as at any time since it commenced building them, and is compelled to work nights in order to fill some very urgent contracts.

THE HUBLEY MANUFACTURING CO., Lancaster, Pa., which manufactures complete equipments for electric railway and lighting plants, is at present doubling the capacity of its works to accommodate the enormous increase in the demand for its apparatus.

MESSRS. H. B. COHO & CO. report the sale this week of Mather generators to the E. P. Gleason Manufacturing Company, and to Mr. Henry Reinhard, eighty-sixth Sreet and Third Avenue. This is the second machine they have installed to Mr. Reinhard this summer.

THE MORGAN ENGINEERING COMPANY, Alliance, O., will supply to Jones & Laughlin, of Pittsburg, who are constructing a new roll shop in connection with their mills, one of its standard construction traveling cranes, all motions of which are operated by electric motors. The lifting capacity of the crane is 15 tons, and the span about 40 feet.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been experiencing a very satisfactory trade during the month on its two-wire specialties, Paranite rubber covered, for inside work and "O. K." weatherproof, for line work. Numerous large orders have been received, and coming as they do so early in the season, certainly promise well for a handsome fall trade.

WARREN WEBSTER, of Warren Webster & Co., Camden, N. J., has been awarded a patent for a feed-water heater and purifier, which obviates the necessity of requiring steam to enter such apparatus at a pressure in excess of that of the atmosphere in order to get rid of air which at times accumulates in the top of the chamber and renders the apparatus useless until expelled.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has issued a 16-page catalogue devoted to multi-polar generators and motors. Illustrations are given of 45 kw. and 11¼ kw. machines, and of the type of armature used, both wound and unwound. A wire formula and table are given for 100 and 500 volt circuits, which will be found useful by the electrician.

THE DODGE MANUFACTURING COMPANY, Mishawaka, Ind., has issued a 200-page duodecimo catalogue, "B 4," of appliances for the transmission of power. Numerous illustrations and lists are given of wood pulleys, shafting and shafting fittings, clutches, etc. An interesting section is that devoted to rope transmission, from which the engineer may derive much information.

R. F. DOWNING & COMPANY, customs and forwarding agents, Corn Exchange Bank, New York, make a specialty of attending to electrical importations. With branches at London, Liverpool, Glasgow, Paris, Hamburg and Bremen, they have unusual facilities for accepting delivery of goods direct from the manufacturers and forwarding them under advantageous conditions, as well as passing them through the custom house expeditiously.

THE HOPPES MANUFACTURING COMPANY, g eld, O., are now

busily engaged installing four of its live steam feed-water purifiers, of 3,000 horse-power total capacity, in the new electric station of the Lindell Railway Company, at St. Louis, Mo. The Hoppes Company feels somewhat elated over this contract, as it was only secured after a hard fight, and in the face of very strong competition. Among other recent sales to electrical companies we note the following: Live steam feed-water purifiers of 1,500 h. p. to The Indianapolis (Ind.) Light & Power Co., and 150 h. p. to The Cincinnati (O.) Street Railway Co.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have received the contract for the new plant of the Fairfield Copper Company, at Monroe, Conn. The plant will be entirely of iron and steel, no woodwork being used about the construction. The new power station for the Hartford Street Railway Company, at Hartford, Conn., will be designed and built by the same company. It will be 66 feet wide and 233 feet in length, with a steel frame covered with anti-condensation corrugated iron covering. When completed it will be one of the most complete stations of the kind in the country, and will be absolutely fire-proof.

THE AMERICAN ELECTRICAL COMPANY, St. Louis, Mo., sends us a handsome pamphlet with its imprint, entitled, "St. Louis, 1894." The brochure is profusely illustrated with views of notable streets and public, office and manufacturing buildings, and also of the parks, gardens and monuments with which the city is embellished. The descriptive matter deals thoroughly with all the various public and private interests that give the city standing. We learn from a table that the number of the electrical workers is rated at 500, which is doubtless an understatement if those employed in lighting and power stations are included.

"REORGANIZATION SALE," QUEEN & CO., incorporated, of Philadelphia, inform us that in order to effect a nearly and satisfactory reorganization of their company, it is considered necessary to make a prompt reduction in merchandise stock, and in this connection particularly call attention to their standard electrical instruments, such as "magnetic vane" switch-board volt meters and ammeters, Deprez-Carpentier portable volt meters and ammeters, Cardew standard voltmeters, electro dynamometers, milli-ammeters, portable astastic and d'Arsonval galvanometers, "Acme" and "Decade" portable testing sets, silver chloride testing batteries, portable photometers, etc.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., are now represented on the Pacific Coast by the following contractors for their apparatus: H. B. Gregory & Co., Portland, Ore.; The Will & Finck Co., San Francisco, Cal. The Machinery Supply Co., Los Angeles, Cal. It also reports the closing of an important contract with the Phelps Publishing Co., of Springfield, Mass., publishers of "The Springfield Homestead," "The American Agriculturist," "The Farm and Home," etc., for the complete equipment of their extensive plant with electric power. The new slow speed motors of The Mather Company will be used throughout in sizes from 20 to 50 h. p. the power being supplied from the Springfield station of the United Electric Light Company. This installation, when completed, will be one of the largest of its kind in New England.

TAYLOR & CLARK, 510 Arch street, Philadelphia, Pa., the well-known supply house, have decided to enter the manufacturing field, making a specialty of knife switches and switchboards of every description. Their present factory, located at Fifty-second street and Lancaster avenue, has been fully equipped for the rapid production of all classes of electrical work, including the making of storage batteries and the rewinding of motors and dynamos.

THE LANCASTER RAILWAY CONSTRUCTION COMPANY, Lancaster, Pa., has been awarded a contract by the Pennsylvania Traction Company, for building twenty-three miles of electric railway in Lancaster county. The line will run from Lancaster to Manheim, Lancaster to Mechanicsburg, New Holland, Blue Ball and Terre Hill, with an eight-mile branch from Mechanicsburg to Ephrata. The specifications call for Pennsylvania Railroad standard construction, including switch and signal system. The overhead construction and all equipment will be of the highest grade, and must be completed, ready for service, within ninety days. The Lancaster Railway Construction Company is a chartered corporation with the following officers: Henry Bumgardner, president; Michael Reilly, vice-president; F. H. Steacy, secretary; J. E. Hubley, treasurer, and H. E. Crilly, superintendent of construction.

Business Notices.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 21, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.

524,983. APPARATUS FOR SUPPLYING ELECTRICITY FOR LIGHT AND POWER PURPOSES; Milton M. Kohn, Chicago, Ill. Application filed September 24, 1891. The combination with an electric battery comprising a number of cells electrically connected in series, of means for cutting out old cells and simultaneously cutting in new cells to keep the strength of the battery constant, and means for preventing short circuiting of the cells.

524,981. ELECTRIC-ARC LAMP; Rudolf Hermann Jahr, Opladen, Germany. Application filed April 19, 1894. The combination, in an electric arc lamp, of a horse-shoe electro-magnet having two adjacent poles of like name, an armature placed with one end between said poles and mounted so as to be capable of oscillation in a horizontal plane, a winding placed in the main circuit of the lamp for exciting one of the said poles, and a winding placed in a derivation to the luminous arc for exciting the other one of said poles.

524,980. ELECTRIC WIRE COUPLING; Charles K. Hall and William B. Lillard, New Orleans, La. Application filed December 8, 1893. In an electric wire coupler, the combination with two wires insulated from each other; of a hollow metal coupler head having one of the wires electrically connected thereto; a metallic spring plunger mounted in said coupler head and insulated therefrom, the second wire being electrically connected to said plunger, and an electrical conductor extending from said plunger toward the side of said coupler head and adapted to complete the circuit when said plunger is pressed forward.

524,977. UNDERGROUND CONDUIT FOR ELECTRICAL CONDUCTORS; James F. Cummings, Detroit, Mich. Application filed January 17, 1893. An underground conduit for electric conductors, consisting of a series of tubes divided longitudinally and arranged with their ends overlapping, spirally wound binders for the tubes arranged at intervals.

524,976. ELECTRIC RAILWAY SUPPLY SYSTEM; James F. Cummings, Detroit, Mich. Application filed September 22, 1892. In an electric power system for railways, the combination with two insulated supply conductors, two distributing conductors divided into sections independently connected by feeders to main supply conductors, of a switch at a central station having contacts connected by independent test lines with the sections of the distributing conductor, an independent source of electricity having one terminal connected to the movable contact of the switch and the other to the ground, and an electric indicating device in circuit with said source of electricity.

524,973. FIRE ALARM SYSTEM; Joel Wales White, Providence, R. I. Application filed May 28, 1894. A fire alarm system comprising a closed circuit containing a resistance and translating device, an open circuit containing a translating device, a thermostat having three electrodes, a shunt around the resistance closed by two or three thermostatic electrodes, and the open circuit arranged for closure by the third thermostatic electrode.

524,847. ELECTRIC DANGER SIGNAL FOR RAILWAYS; Archibald B. Murray, San Rafael, Cal. Application filed March 17, 1893. In an electrical signalling and alarm system for railways, a closed main circuit in the engine including as part of it the armature, a magnet and a circuit breaking trip lever; an obstruction on the track, a circuit breaker at a relatively distant point electrically connected to a rail and to the said obstruction, and positively operated by the movement of said rail, and another magnet in the engine having a bell-sounding armature and in open circuit with the battery, all arranged so that in case the main circuit is broken at both trip-lever and distant point, the armature will close an independent bell circuit on the engine.

524,845. AUTOMATIC REGULATOR FOR DYNAMOS; Henry D. Symmes, St. Catharines, Canada. Application filed June 6, 1894. In an automatic electric regulator for dynamos, two or more solenoids arranged in series as regards the main circuit, and in multiple arc as regards one another in combination with two or more resistance circuits connecting the positive and negative wires of the main circuit, each having a contact therein and each solenoid being arranged to break its corresponding resistance circuit when a current of more than a pre-determined number of amperes passes through the main circuit.

524,850. INSULATOR; Charles N. Hammond, Boston, Mass. Application filed December 18, 1893. An insulator comprising a mass or block of suitable material formed with a wire-receiving groove or depression and holes on opposite sides of such grooves or depression, a wire retainer having a stem which is placed in one of said holes and a hook-shaped head which overlies the wire in the groove or depression and has its own down-turned point entered into the other of the said holes, and a securing device applied to the said stem.

524,881. ELECTRIC HEATER; Tapley W. Young, Washington, D. C. Application filed October 6, 1893. An electric heater comprising a water-tight case having an insulated chamber at each end, a metal core having insulated bores packed with a suitable resistant material arranged within the case, between the insulated chambers, binding posts located in said chambers, electrical conductors attached to said binding posts and extending within the core, electrodes attached to said conductors, electrical connections between the bores in the core, and means for passing a current of electricity to the binding posts.

524,884. COMMUTATOR FOR DYNAMO: ELECTRIC MACHINES; George F. Card, Covington, Ky. Application filed January 8, 1894. In a commutator, the combination with the armature shaft, of cap-plates mounted hereon, a series of segments carried by the cap-plates, and a packing interposed between said plates.

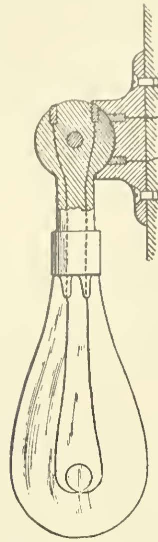
524,911. APPARATUS FOR TRANSFORMING CONTINUOUS ELECTRIC CURRENTS INTO ALTERNATING CURRENTS; Franz Sevirin Ferdinand Schneider, Fulda, Germany. Application filed March 20, 1894. In a transformer, the combination with two electromagnets included in two primary circuits and a battery common to both circuits, of a rocking armature carrying contacts operating to alternately make and break said circuits, and a secondary conductor having its terminals connected with the primary circuits between the magnets and the circuit breakers.

524,844. ELECTRICAL TESTING SWITCH; Henry Smith, Buffalo, N. Y. Application filed March 29, 1894. Consists of a simple and compact arrangement of binding posts, contact buttons and switch-lever so placed upon a switchboard as to enable the operator to ground the circuit either to the right or left of the stations at which it is placed, or cut out the station entirely if desired.

524,823. ELECTRIC RAILWAY CAR; John C. Henry, Westfield, N. J. Application filed August 27, 1892. An electric car comprising a swiveling truck

at one end, and at the other a motor, a single pair of wheels baving their axle journaled in one end of the motor frame, a rigid tongue fastened to the other end of the motor and flexibly attached to the swiveling truck, and a car body supported at one end on the frame of the motor at a point in the rear of the single axle

524,711. PRINTING TELEGRAPH; Robert A. Fowden, Philadelphia, Pa. Application filed December 22, 1893. In a printing telegraph system, a printing circuit, an electric motor, and a vibrating mechanical and centrifugal acting circuit closer and breaker operating to close and interrupt said circuit.

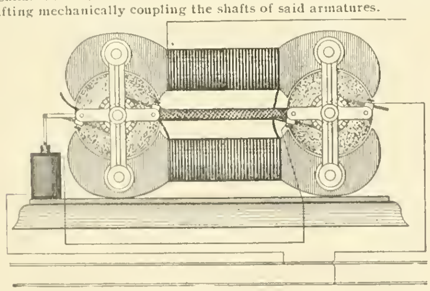


No. 524,706.—Electric Light Support.

524,710. METHOD OF PRODUCING ELECTRODES; Desmond Gerald Fitz-Gerald, London, England. Application filed November 7, 1893. The process of manufacturing battery electrodes which consists in treating one or more of the lower oxides of lead with an alkaline hydrate, converting the caustic alkali into carbonated alkali by exposure to carbonic acid, and treating the resulting mass with a solution of sulphate of magnesia.

524,706. ELECTRIC LIGHT SUPPORT; William H. Connell, Wilmington, Del. Application filed January 21, 1894. The combination with a bracket, of an arm pivoted on and supported entirely by said bracket, an incandescent electric lamp secured to the end of the arm so that the pivotal axis of the arm and the axis of the lamp are out of line with each other, an electric circuit leading to said lamp and contact points operated by the swinging of the lamp carrying arm for closing said circuit at a definite point in the travel of the lamp.

524,852. MOTOR GENERATOR; John C. Henry, Westfield, N. J. Application filed December 18, 1891. In an electro-magnetic machine, the combination of suitable fields, two armatures revolving in relation thereto, and flexible shafting mechanically coupling the shafts of said armatures.



No. 524,852.—Motor-Generator.

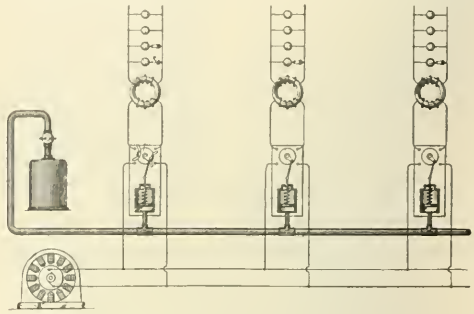
524,953. ELECTRIC METER; Carl Daniel Raab, Kaiserslautern, Germany. Application filed January 18, 1894. An electric motor meter comprising the revolving armature having the coils in a shunt, the damping disks adjacent to the armature, the stations coils and conductors and the mica disks interposed between the armature and the damping disks wherebythe air damping will be reduced.

524,749. SYSTEM OF ELECTRICAL DISTRIBUTION; George Westinghouse, Jr., Pittsburgh, Pa. The combination with a series of electric converters and a circuit for supplying the primary coils thereof, of circuit-controlling devices applied to the respective primary coils for opening and closing the circuit connections thereof, and fluid pressure devices for operating said circuit controlling devices.

524,717. SAFETY SWITCH FOR HIGH POTENTIAL CIRCUITS; Samuel Harris, Cleveland, O. Application filed June 14, 1894. The combination of a non-conducting disk a single contact-block on each side of said disk at diametrically opposite points with connections to the circuit, a rotating stem extending through the disk and having on each side thereof and diametrically opposite each other a contact arm adapted to make circuit with the contact blocks, said contact arms being conductively connected and rotating in planes parallel to the disk, and an index or handle on said stem for operating the switch.

524,758. ELECTRICAL RAILWAY SIGNAL; Lawrence Dornberger, Highland Falls, N. Y. Application filed April 17, 1894. In a railway signal, the combination with the signal arm; of automatically operated gear devices connected with the said signal arm for adjusting the same, a stop wheel mounted on one of the shafts of the gearing, a catch-pawl for said stop wheel, a trip lever to disengage said pawl from the stop wheel, and an electrically controlled catch for said trip lever.

524,773. ELECTRIC RAILWAY SUPPLY SYSTEM; Malone Wheless, Washington, D. C. Application filed July 7, 1894. Involves the use of contact pins with which the terminal of feeders from the main cable and which are placed at intervals in the track or roadway upon which the car runs, these contacts being successively met by a shoe on the car through which the



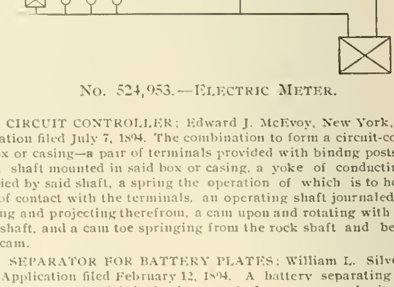
No. 524,749.—System of Electrical Distribution.

current is led to the motor. Each feeder connection has in it normally open contacts which are controlled by a pick up magnet located at that point; this pick-up magnet, although located in the track, being energized from a source of electrical supply on the car through suitable circuit connections.

524,785. CONTROLLER FOR ELECTRIC CARS; Marion Baker Monroe, New Orleans, La. Application filed February 28, 1894. In an electric car, the combination of a motor, a source of electric supply, a rheostat arranged in an electric circuit between the source of supply and the motor, a vertically movable plunger arranged in the electric circuit and contacting with the rheostat, and a suitable means for moving the said plunger.

524,789. ELECTRICAL SUBWAY SYSTEM; John C. Reilly, Brooklyn, N. Y. Application filed May 28, 1894. The combination of an iron subway pipe, manholes at suitable intervals, a slotted tube upon the interior of said pipe with drawing-in devices extending without interruption from manhole to manhole, and a series of five-way couplings interposed in the main duct between manholes, connected with tubes for branch conductors and a vertical tube extending to the surface of the street.

524,793. COMMUTATOR CYLINDER; Alton J. Shaw, Muskegon, Mich. Application filed June 7, 1894. In a commutator, the combination with the conducting bars, of collars at the ends of said bars, one or both of said collars being formed of resilient material and adapted to yield under the pressure due to longitudinal expansion of the bars.



No. 524,953.—Electric Meter.

524,808. CIRCUIT CONTROLLER; Edward J. McEvoy, New York, N. Y. Application filed July 7, 1894. The combination to form a circuit-controller—of a box or casing—a pair of terminals provided with bindng posts, a rotating rock shaft mounted in said box or casing, a yoke of conducting material carried by said shaft, a spring the operation of which is to hold the yoke out of contact with the terminals, an operating shaft journaled within the casing and projecting therefrom, a cam upon and rotating with said operating shaft, and a cam toe springing from the rock shaft and bearing upon the cam.

524,843. SEPARATOR FOR BATTERY PLATES; William L. Silvey, Dayton, O. Application filed February 12, 1894. A battery separating plate consisting of a porous fabric having notched passageways in its edges, the edge of the plate only combined with a preservative material.

The Electrical World.

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CONTENTS.

RESUSCITATION FROM ELECTRIC SHOCKS.

We print elsewhere a valuable paper by Dr. Augustin H. Goelet, late president of the American Electro-Therapeutic Association and one of the leading authorities on electro-therapeutics in the world, which gives a detailed account of the treatment to which a patient shocked by electricity should be subjected. In order to more clearly teach the manipulations of the method for reviving the subject, our artist, under the direction of Dr. Goelet, has prepared illustrations which make an understanding of the processes very simple. It will be noted that Dr. Goelet refers to the treatment as being similar to that employed for reviving a person from an exaggerated faint, rather than the treatment usually applied to the drowned. There is, however, much resemblance between the methods, and the phrase of D'Arsonval is useful in fixing the general principles of the remedy to be applied. The endorsement which Dr. Goelet gives to the statements of D'Arsonval adds to the necessity of those engaged in electrical pursuits becoming familiar with the proper system of treatment, and which they now have placed before them. In order that the directions may be in a form most convenient for preservation and reference, we shall reprint the article on a separate sheet and a copy may be had by any of our readers upon application.

COST OF ELECTRICAL ENERGY.

In this issue we reprint the concluding section of Mr. E. Ray Stevens' paper on "Electric Lighting in England," which has dealt very thoroughly with that subject and particularly with the cost of generating current for lighting. While the various data of the cost of production are of much value, yet the differences in the figures given are considerable, which perhaps are to be partly ascribed to different methods of accounting, notwithstanding the Board of Trade requirements of uniformity, or to the abnormal conditions naturally prevailing in new stations, though a knowledge of the load factor would doubtless clear up some of the contradictions. The table given in the present section of the average actual cost per kilowatt-hour of generating electric current for lighting in British stations, is of much interest, and gives support to the conclusions we have arrived at in these columns. It will be seen that the average cost per B. O. T. unit (kilowatt-hour), exclusive of interest, depreciation and sinking fund charges, is 8.35 cents for private stations, which would bring the total cost to over 10 cents per kilowatt-hour, or over 7½ cents per horse-power-hour. It is difficult to see any reason for the lower cost given for generating current in municipal stations—6.06 cents per kilowatt-hour—and we are inclined to think that the American practice of forcing a favorable balance sheet to make a good showing for municipal stations is not unknown in Great Britain.

LA LUMIERE ELECTRIQUE.

What we have feared for a long time has now become a fact, for we learn with regret that the publication of our highly esteemed French contemporary, "La Lumiere Electrique," has been suspended. Our suspicions were aroused again lately by the failure to receive any issues later than that of August 4, and they have been confirmed by the receipt of a formal notice that the publication will be suspended awaiting a reorganization of the financial department. It has been conducted at a loss of about $14,000 a year, during a period of many years, the funds having been furnished by its director, Dr. Cornelius Herz, of whom it may be truly said that he loved his noble journal, keeping up its high standing and excellent appearance at a sacrifice which few men would be willing to make, year after year, for the cause of science. The journal, con-

ducted formerly by the late Count du Moncel, has always retained its high rank as the leading purely scientific electrical journal of the world, and it is undoubtedly due to its having limited its field too exclusively to purely scientific matters that it did not succeed financially. In our opinion the proper place for the publication of valuable but purely scientific papers on electrical subjects is in some of the standard journals devoted to pure science and physics in general. An electrical journal of the present time should devote itself more to the important industrial applications of electricity, at the same, time keeping its readers informed of the *results* of the purely scientific researches in the electrical field, giving, at the same time, references to the publication of such researches in the physical journals. We heartily wish "La Lumiere Electrique" success in the reconstruction of its financial department, and hope to find that its publication will be resumed, but we venture to predict that a somewhat different policy will have to be adopted. It is curious to find that the same person who has shown such substantial devotion to pure science and to his highly appreciated journal, has such an unenviable reputation in his former home, America, and has voluntarily banished himself from France to avoid arrest and trial for his improper connection with the Panama Canal scandal in France.

LOCOMOTIVE vs. STATIONARY ENGINES.

One of the maxims of war is not to underrate your antagonist, and it is a maxim that applies as well in other vocations. The victories of electricity have heretofore been so easily won that the confidence thereby instilled is apt to cause the real strength of an adversary to be under-estimated. Much, for example, has been said of the great inefficiency of locomotive engines as compared with stationary types, and many of the predictions in regard to steam traction being displaced by electricity have been based upon this assumption. A French engineer, M. Desdouits, has recently published the results of a thorough investigation of the relative economy of locomotive, stationary and marine engines from numerous dates of tests of the various types. From the comparisons of water consumption he concludes that the locomotive engine, either of the usual form with a single valve, or of the improved form working compound, or with Corliss valves, is susceptible of as great economy as the best stationary or marine engines having the same system of steam distribution, and that working with a condenser it has a marked advantage. He finds that the consumption of water in a locomotive with a single valve under favorable conditions as to cut-off and pressure, can be lowered to 24.25 pounds per I. H. P., 23.15 pounds being a limit corresponding to the most perfect condition of regulation. The compound system permits the consumption to be lowered to 22 pounds, and the Corliss system used on the State Railway of France gives the same figure. Under the usual conditions of construction and working of locomotives, it is stated that the consumption of water varies from 24.25 to 26.5 pounds, and, where a high power is required at moderate speeds, it may rise to 28.75 pounds or even more under exceptional circumstances. We doubt if these results are exceeded in our power stations of to-day, though they do not equal those of published tests of stationary engines. It may be remarked, however, that such tests are usually to be received with much caution, for the great differences in the performance of the same type of engine as reported by different experts, cannot be accounted for on rational grounds, and justify the suspicion with which the data of engine efficiency trials are in general regarded by engineers.

NATIONAL AND MUNICIPAL OWNERSHIP IN ENGLAND.

We have before referred to the measures being undertaken in England toward bringing long-distance telephony under the control of the general government, and one of our London contemporaries enables us to give some further particulars. It seems that the original licenses to telephone companies were only for restricted areas, and did not permit long-distance or inter-town lines. In 1884, however, such lines, called trunk lines in England, were authorized, but recently an agreement has been perfected, though not yet ratified by the government, through which the companies will relinquish their concessions to all lines outside of exchange areas, receiving in payment a sum 10 per cent. in excess of the estimated cost price, the Post Office to take possession after July 1 of next year. In exchange areas where trunk and subscribers' lines cannot well be separated, the Post Office will enter into a partnership arrangement for common maintenance. It is predicted that when the measure comes before the House of Commons for final action, a strong effort will be made to authorize the municipal ownership of telephone exchanges, with some prospect of success. The doctrine of municipal ownership seems to be strongly entrenched in Great Britain; the great majority of new lighting stations have been erected by municipalities, and the recently organized London County Council would, we fear, be considered dangerously socialistic in this country from its tendencies toward the principles of which the cases referred to are applications. The business administration of English municipalities renders such experiments there of value, for the results, whether favorable or unfavorable, will be logical ones and not subject to complication from political corruption. The outrageous interference of corrupt politics in so many of our municipal projects of a similar nature should cause us to hesitate to adopt the English idea, which is administered upon the same business principles that would guide a private owner, and is otherwise doomed to failure. If an example is wanted of the evils that may spring from following an idea, however good it may have proved to be elsewhere, without consideration of the conditions involved, the case of Detroit may be pointed out. The establishment of a municipal plant there has apparently been the occasion for an orgie of corruption, and if the plant is ever finished it promises to be merely a constant source of venality.

COMPARING DRY CELLS.

In discussing some recent comparative tests of dry cells of different makers, a London contemporary highly endorses the conclusions of the expert to use, as a unit of comparison, the *bulk* of the cells. We fully recognize the difficulty in selecting some unit of comparison for such cells, as also for cells of the Leclanche type in general, but we cannot agree entirely with our contemporary that "no other test than that of taking cells of a similar size can be really of value." For purely scientific researches it may be that this unit is as good as any other, or perhaps the best of a poor lot to choose from, but as the practical results are really what such tests are intended to determine, it seems to us that a different unit of comparison might be more satisfactory, at least to the users and purchasers of the cells, who, after all, are those for whom such reports are usually intended. In all but a few cases there is generally plenty of room for placing such cells, and their bulk is therefore of little importance to the user, at least within reasonable limits; he is interested chiefly in two factors, the first cost of the cell and the operation, including its behavior, life, capacity, cost of maintenance, etc. A comparison of two cells, to be of interest to the purchaser, should therefore be based on the cost as a unit, and only in comparatively few cases on the bulk or weight. If one cell behaves much better than another or has a greater output, it will certainly be preferred by the purchaser, if the price is the same, notwithstanding that its bulk or weight may be somewhat greater. If one maker chooses to use a thicker zinc or more solution, and is willing to sell the cell for the same price, why should he not get the credit for it, instead of having his cell pronounced inferior, as it would be if it was ranked according to size. A good unit to use, therefore, would be the *cost* of the battery and its maintenance for doing a certain definite amount of work during a certain time, assuming, of course, that this amount of work is properly chosen. It may be claimed that it is unscientific to introduce the cost as the fundamental unit, but if such tests are made to inform the public which is the better cell for it to buy, we think there is no more rational and satisfactory unit of comparison. In justice to Prof. Jamieson, whose tests are the ones referred to, it should be stated that he merely selected two cells of about the same bulk and does not appear to claim that this was the best way of comparing cells in general.

How to Deal with Apparent Death from Electric Shock.

BY AUGUSTIN H. GOELET, M. D.

Much interest has recently been excited by the report from France of the resuscitation of a man apparently killed by elec-

FIRST POSITION.

tricity, and by the announcement of the French scientist d'Arsonval that a person so shocked should be treated as one drowned. The suggestion is a good one but may be somewhat misleading

SECOND POSITION.

unless understood; that is, unless the person undertaking the resuscitation appreciates what is to be accomplished and just how it is to be done.

As this authority says, an electric shock may produce death in one of two ways, viz:

(1) By producing destructive tissue changes, when death is absolute; or (2), by producing sudden arrest of the respiratory and heart muscles through excitement of the nerve centres, when death is only apparent; in other words animation is merely suspended. The subject may be aroused from this syncope if efforts at resuscitation are not too long delayed.

The alternating current, which is usually regarded as the most deadly, strange to say, nearly always produces death in this second manner.

To say that a person has received a shock from a wire conveying a current of four or five thousand volts, does not necessarily signify that the body has been subjected to the full force of the current, even if the meter does register nearly one ampere during the time of the accident. In view of the fact that the human body offers a resistance of several thousand ohms, which resistance is greatly increased by imperfect contact, and by charring and burning the tissues at the points of application, it is not often that the internal structures or vital organs are submitted to a very considerable volume of current, though it apparently passes through the body. It must be borne in mind that when the clothing is moist with perspiration or wet with rain, it offers a circuit of less resistance than the human body, and in this event the body receives only a shunt current very much less in quantity than the main current. The bulk of current, in this instance, passes over the surface and does not enter the body. This may explain the survival of some who have apparently withstood very powerful currents.

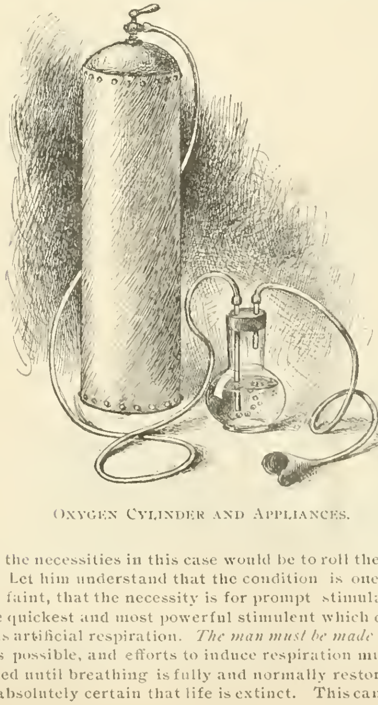
It must be presumed, therefore, that electricity seldom kills outright, though the condition of suspended animation, which it induces, would result in death if not counteracted.

All things considered, it is rational to attempt the resuscitation of those apparently killed by electricity, and if not too long delayed, the effort promises fair chances of success, provided proper means are instituted.

If the body has actually been submitted to a current of sufficient volume to produce destructive tissue changes, all efforts at resuscitation will, of course, be futile.

If, on the other hand, only respiration and the heart's action have been temporarily arrested, there is a condition of syncope simulating apparent death by drowning, or from anæsthetics, and the physician knows that patients in this condition are frequently revived. Laymen will appreciate the nature of this condition if it is explained as one of exaggerated faint and would not feel appalled upon encountering it if previously instructed how to cope with it. In an ordinary fainting spell the necessity to stimulate is universally appreciated. In syncope resulting from an electric shock stimulation is likewise indicated, but more vigorous measures are required. This is the only difference.

As said above, the direction to treat one shocked by electricity as one drowned may be misleading, as the conception of the layman of the necessities in this case would be to roll the body on a barrel. Let him understand that the condition is one of exaggerated faint, that the necessity is for prompt stimulation, and that the quickest and most powerful stimulent which can be employed is artificial respiration. *The man must be made to breathe*, if this is possible, and efforts to induce respiration must not be suspended until breathing is fully and normally restored or until it is absolutely certain that life is extinct. This cannot be assured in less than an hour's persistent, energetic, tireless effort.



Oxygen Cylinder and Appliances.

The accompanying illustrations will serve to make intelligible the following directions for artificial respiration:

The body must be placed upon the back. A roll made of a coat or anything else convenient (*rolled*, not folded) is placed under the shoulders, and must be sufficiently large to so prop the spine up as to drop the head backwards. The operator should kneel behind the subject's head, facing him, grasp the elbows and draw them well over the head, so as to bring them almost together above it, and hold them there for two or three seconds. Then he carries them down to the sides and front of the chest, firmly compressing it by throwing his weight upon them. After two or three seconds the arms are again carried above the head and the same manœuvre is repeated, at the rate of fifteen or sixteen times per minute. At the same time the tongue must be drawn out to free the throat. This manipulation stimulates respiration in the following manner, viz.: When the arms are extended over the head, the chest-walls are expanded, just as in inspiration, and if the throat is clear the air will rush into the lungs. When the arms are brought down to the sides of the chest, compressing it, the air is expelled, just as in expiration.

An Improvised Mouthpiece.

This is the most convenient and reliable manner of inducing artificial respiration. It is known as Sylvester's method. The operator must, however, appreciate the fact that this manipulation must be executed with *methodical deliberation* just as described and never hurriedly nor half-heartedly. To grasp the arms and move them rapidly up and down like a pump-handle is both absurd and absolutely useless.

In addition to this, if an assistant be at hand, the tongue, held by a cloth or handkerchief to prevent slipping, should be seized and drawn forcibly out during the act of inspiration or when the arms are extended above the head, and when the chest is compressed it may be allowed to recede. This rhythmical traction upon the tongue is in itself an excellent stimulant of respiration. It acts not only by freeing the throat of the tongue, which may fall back and obstruct breathing, but also by reflex irritation, through the fraenum or bridle under the tongue being drawn forcibly against the lower teeth.

Should these efforts fail to elicit any response or arouse any signs of life, recourse may be had to another method of stimulation by exciting the dormant nerve centres. This should, however, be reserved for the physician, who should always be summoned when it is possible to get one, or should be made use of only by one who realizes the injury that may be done if it is carelessly practiced. Still, when the necessity is great and other means have been exhausted, some risk is allowable.

I refer to forcible stretching of the sphincter muscle controling the rectum or lower bowel. It is well known to physicians that this muscle is the last portion of the body to lose its sensibility and that by irritating it by forcibly stretching, a gasp will often be elicited from one actually moribund.

The method of procedure is this:

Turning the patient on the side, the index finger or thumb is

inserted into the rectum and the muscle, which, if sensible, will be felt to resist, should be forcibly and suddenly drawn *backwards*, towards the spine. Care must be taken not to introduce the finger roughly, or to use sufficient force to lacerate or wound the parts.

Having obtained one gasp, artificial respiration should be continued and a repetition of the proceeding should be reserved until respiration again fails. In some instances, however, it may be necessary to repeat this with every effort at inducing inspiration, that is, every time the arms are extended over the head. The subject then being on the back, the knees are drawn upwards to facilitate access to the rectum.

If the accident occurs in a city or large town, oxygen, which may be obtained at every drug store may be used. This is a powerful stimulant to the heart if it can be made to enter the lungs.

This gas comes in cylinders furnished with a stop-cock and tubes and bottle, which latter is to be half filled with water through which the gas passes when turned on. [See figures.] If a cone or mouth-piece is not furnished with the apparatus, one can be hastily improvised from a piece of stiff paper and attached by a string to the ordinary mouth piece. To use the oxygen, place the cone over the patient's face and turn on the stop-cock until the gas is seen to bubble freely through the water in the bottle. Efforts at artificial respiration should be kept up while the gas is being administered to favor its entrance into the lungs.

The use of electricity to re-awaken the heart and lungs to action offers another auxiliary to the resuscitation process, but implies the skilled employment of special electrical apparatus purely within the possession of the physician, who naturally does not require instruction.

When I was requested by the editors of THE ELECTRICAL WORLD to contribute this article I gladly accepted because:

(1) I am convinced that many who have died in consequence of electrical shocks might have been saved if those at hand had been properly instructed in the methods of reviving suspended animation, and,

(2) I hope all electrical companies will be impressed with the importance of having their linemen and other employees engaged in the vicinity of dangerous currents, so instructed and trained that without delay methods of resuscitation can at once be instituted.

Thus the giant electricity will more surely become man's servant, a faithful and ever obedient one, instead of as now, occasionally, through man's carelessness, his slayer.

Dynamo-Electric Machinery—VI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

MAGNETIC FLUX.

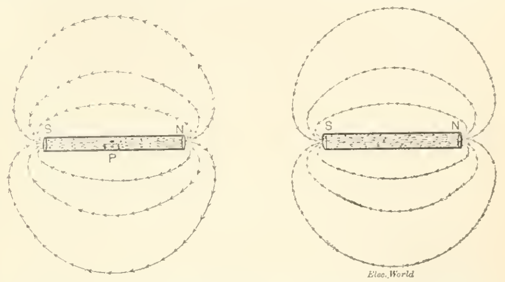
22. A magnet is invariably accompanied by an activity in the space or region surrounding it. Every magnet produces a magnetic field or flux, which not only passes through the substance of the magnet itself, but also pervades the space surrounding it. In other words, the property ordinarily called magnetism, is, in reality, a peculiar activity in the surrounding ether, known technically as *magnetic flux*.

By a simple convention, magnetic flux is regarded as passing out of the north-seeking pole of a magnet, traversing the space surrounding the magnet, and finally re-entering the magnet at its south-seeking pole. Magnetic flux or magnetism is circuital; that is, the flux is active along closed, re-entrant curves.

23. Although we are ignorant of the true nature of magnetic flux, yet, perhaps, the most satisfactory conception we can form concerning it, is that of the ether in translatory motion. In other words, that in a magnet, ether is actually streaming out from the north-seeking pole and re-entering at the south-seeking pole.

Since the ether is assumed to possess the properties of a perfect fluid, i. e., to be incompressible, readily movable, and almost infinitesimally divisible, it is evident that if a hollow tube, or bundle of hollow tubes, of the same aggregate dimensions as a magnet, be conceived to be provided internally with a force pump in each tube, and that such tube be placed in free ether, then on the action of the force pumps a streaming would occur, whereby the ether would escape from one end of the tubes, traverse the surrounding space, and re-enter at the other end of the tubes. Moreover, if the stream lines, through which the ether particles would move under such ideal circumstances were mapped out, they would be found to coincide with the observed paths which the magnetic stream lines take in the case of a magnet.

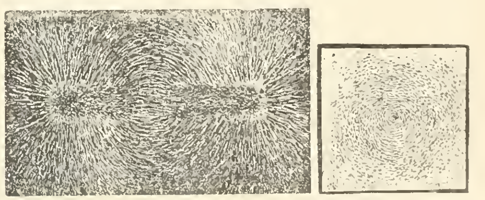
Similar stream lines could be actually observed in the case of a hollow tube provided internally with a pump, and filled with and surrounded by water; only, in this case, on account of the friction of the liquid particles, both in the tube, and between themselves, work would require to be done, or energy expended, in maintaining the motion, and unless such energy were supplied, the motion would soon cease. In the case of the ether, however, there being no friction, although energy would probably be required to set up the motion, yet, when once set up, no energy would be required to sustain it, and the motion should continue indefinitely. This is similar to what we find in the case of an actual steel bar



FIGS. 20 AND 21.—DIAGRAMS REPRESENTING A TUBE, IMMERSED IN WATER, WITH A FORCE-PUMP AT ITS CENTRE.—HYDROSTATIC STREAM LINES, AND A CYLINDRICAL BAR OF IRON, MAGNETIZED. I. E., WITH A M. M. F. ACTIVE WITHIN IT.—MAGNETIC FLUX STREAM LINES.

magnet. The above theory is merely tentative, and the real nature of magnetism may be quite different; but assuming its correctness, there is no knowledge as to the pole of the magnet from which the ether issues. It is assumed, however, as above stated, to issue from the north-seeking pole.

24. Fig. 20 represents, diagramatically, a tube provided at its center with a rotary pump P, and immersed in water. If the pump were driven so as to force the water through the tube in the direction of the arrows, i. e., causing the water to enter at S and leave at N, then stream lines would be produced in the surrounding water, taking curved paths, some of which are roughly indicated by arrows. Fig. 21 represents the application of this hypothesis to the case of a bar magnet of the same dimensions as the tube. Here the *magneto-motive force* of the magnet, corresponds to the water motive force pump in Fig. 20, and is hypothetically assumed to cause an ether stream to pass through the magnet in the direction indicated by the arrows; namely, to enter at the south pole and issue from the



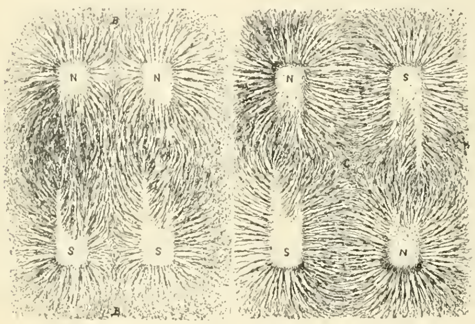
FIGS. 22 AND 26.—DISTRIBUTION OF FLUX ABOUT A STRAIGHT BAR MAGNET IN A HORIZONTAL PLANE, AND ROUND A VERTICAL WIRE CARRYING A CURRENT, AS INDICATED BY IRON FILINGS.

magnet at the north pole, and these ether streams would constitute hypothetically the magnetic flux and would pass through the surrounding space in paths roughly indicated by the arrows. The actual flux paths that would exist in the case of a uniformly magnetized short bar magnet are more nearly shown in Fig. 22. Here it will be noticed that the flux by no means issues from one end only of the magnet, re-entering at the other end. On the contrary, the flux, as indicated by chains of iron filings, issues from the sides as well as from the ends of the bar. The reason for this is evidently to be found in the fact, that each of the particles or molecules of the iron is, in all probability, a separate and independent magnet, and, therefore, must issue its own ether stream independently of all

the rest. The effect is, therefore, the same as if a very great number of minute voltaic cells were connected into a single battery in series, and the whole immersed in a conducting liquid where side leakage can exist.

25. The magnetic field, that is the space permeated by magnetic flux, may be mapped out in the case of any plane section, by the use of iron filings. For example, Fig. 22, before alluded to, as representing the flux of a straight bar magnet, had its flux-paths mapped out as follows: A glass plate, covered with a thin layer of wax, was rested horizontally on a bar magnet, with its wax surface uppermost. It was then dusted over with iron filings and gently tapped, when the iron filings arranged themselves in chain-forms, which are approximately those of the stream-lines of magnetic flux. A satisfactory distribution having been obtained in this manner, the glass plate is gently heated in order to fix the filings. On cooling, the filings are sufficiently adherent to the plate to permit it to be used as the positive from which a good negative picture can be readily obtained by photographic printing.

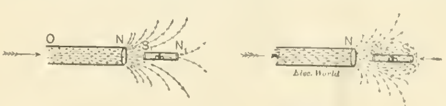
26. A modification of the above process was employed in the case of Figs. 22 A and B, shown below. Here a photographic positive was obtained by forming the field, in the manner previously



Figs. 22 A and B.—Magnetic Phantoms.

explained, on a sensitivized glass plate in a dark room, instead of on a waxed plate; and, after a satisfactory grouping of filings had been obtained under the influence of the field, exposing the plate momentarily to the action of light, as, for example, to a momentary flash of light. The filings are then removed, the plate developed, and the negative so obtained employed for printing.

27. Magnetic flux may vary in three ways, namely: (1) in direction, (2) in intensity, (3) in distribution. The direction of magnetic flux at any point can be readiy determined by the direction assumed, at that point, by the magnetic axis of a very small, delicately suspended compass needle. The compass needle always coming to rest threaded by the flux, which entering at the south pole, and leaving at its north pole, causes the needle to point in the direction of the flux. Assuming that a compass needle may be represented by a little tube containing an ether force pump, the tube would evidently come to rest when the flux it produced passed through it in the same direction as the flux into which it was brought. That is to say, if the needle be brought into the neighborhood of a north pole, it would come to rest with its south pole pointing towards the north pole of the controlling magnet, since in



Figs. 23 and 24.—Analogues Showing Attraction of Opposite Poles and Repulsion of Similar Poles.

this way only could a maximum free ether motion be obtained. If, however, the compass needle be held in the opposite direction i. e., with its north-seeking pole towards the north-seeking pole of the magnet, the two opposed stream lines would, by their reaction, produce a repellent force. These effects are generally expressed as follows: like magnetic poles repel, unlike magnetic poles attract. This statement is not correct, since whatever theory of magnetism be adopted, it is the fluxes and not the poles which exercise repulsion.

28. Fig. 23 represents the action of the flux from a magnet upon a small compass needle, as illustrated by the hydrostatic analogy. The water is represented as streaming through the tube O N, and issuing at the end N in curved stream lines. Suppose the small magnet, or compass needle, S N, also has a stream of water flowing through it, entering at S and leaving at N. Then if the compass needle be free to move about its center of figure, it would come to rest when the stream from the large tube O N flowed through the smaller tube from S to N, that is, in the direction of its own stream.

If, however, the small tube S N is not free to move, but is fixed with its end N towards the end N of the larger tube, as shown, then the opposite streams would conflict, and produce, by their reaction, the effect of repulsion between the tubes.

29. Magnetic flux possesses not only definite direction, but also magnitude at every point; that is to say, the flux is stronger nearer the magnet than remote from it. For example, considering a mag-

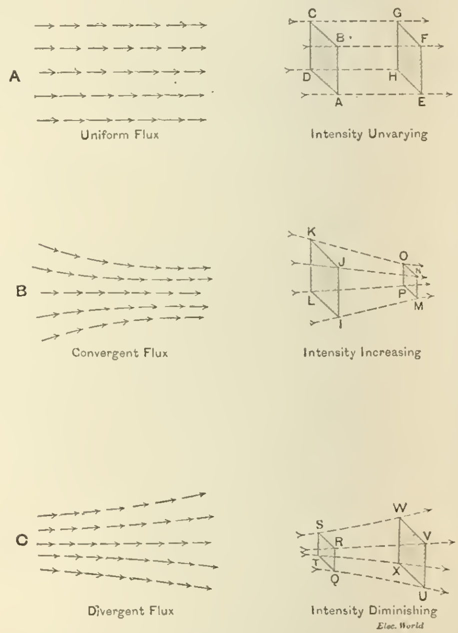


Fig. 25.—Varieties of Flux.

net as being represented by a tube with an ether force pump, the velocity of the ether flux will be a maximum inside the tube and will diminish outside the tube as we recede from it. The intensity of magnetic flux is generally called its *magnetic intensity* or *flux density*.

Faraday, who first illustrated the properties of a magnetic field, proposed the term *lines of magnetic force* instead of magnetic flux, or stream-lines, here employed, and the term lines of magnetic force has been very generally employed. The term, however, is objectionable, especially when an attempt is made to conceive of magnetism as possessing flux density, or as varying in intensity at any point; for, in accordance with Faraday's conception, the idea of an increased flux would mean a greater number of lines of magnetic force traversing a given space. While this might be assumed as possible, still the conception that magnetism acts along lines, and not through spaces, is very misleading, and an endeavor has been made to meet this objection by the introduction of the term *tubes of force*. A far simpler conception is that of velocity of ether, as suggested by the force pump analogue. Here the increased flux density at any point would simply mean an increase of ether velocity at such point.

30. Intensity of magnetic flux is measured in units called *gausses*, after a celebrated German magnetician named Gauss. A gauss is an intensity of the same order as that produced by the earth magnetism

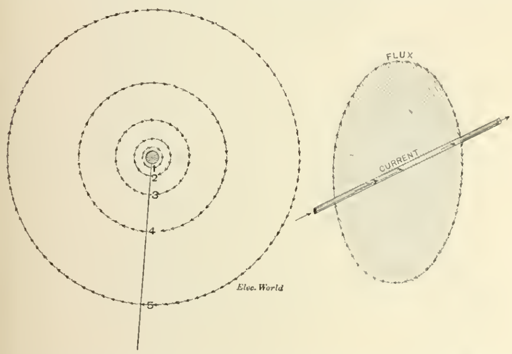
on its surface. For example, the intensity of the earth's flux at Washington is about 0.6 gauss at a dip or inclination of 70°.

Magnetic flux may be uniform or irregular. Fig. 25, A, shows a uniform flux distribution, as represented by straight lines at uniform distances apart. That is to say, uniform intensity at any point is characterized by rectangularity of direction in path at that point. Irregular intensity is characterized by bending, and the degree of departure from uniformity is measured by the amount of the bending. Irregular flux density may be either converging, as at B, or diverging, as at C. Convergent flux increases in intensity along its path, and divergent flux diminishes.

31. When the flux paths are parallel to one another, the intensity must remain uniform. Thus, in Fig. 25 at A, let the area A B C D be 1 square centimetres then the amount of flux which passes through it in this position, or, in our hydrostatic analogue, the quantity of water which would flow through it in a given line will be the same if the area be shifted along the stream line parallel to itself in the position E F G H.

Where the flux converges, as at B in Fig. 25, then the amount of flux passing through the normal square centimetre, I J K L, will further on pass through a smaller intercepting area, say one-fourth of a square centimetre, M N O P, and consequently the intensity at this area would be four times greater, and in the hydraulic analogy the same quantity of water passing per second, flowing through a cross sectional area four times more constricted, will flow there with four times the velocity.

When the flux diverges, as at C, the opposite effect is produced. Thus the flux shown in the figure as passing through the area Q R



Figs. 27 and 28.—Geometrical Distribution of Flux Paths Round a Wire Carrying a Current and Diagram of Relative Directions of Magnetic Flux and Electric Current.

S T, say one-fourth of a square centimetre, would at U V W X pass through one square centimetre, at four times less density, or, in the case of the hydraulic analogyt at one-fourth of the velocity.

32. The existence of a magnetic flux always necessitates the expenditure of energy to produce it. In the case of the ether pump, assuming that energy was required to establish the flow through the tube, this energy being imparted to the ether, becomes resident in the moving ether, so that the ether, plus energy of motion, necessarily possesses different properties from ether at rest. In the same way in the case of a magnet, the energy required to set up the magnetic flux, i. e., to magnetize it, is undoubtedly associated with such flux. Wherever the magnetic intensity is greatest, there the corresponding ether velocity, according to our hypothesis, is greatest, and in that portion of space the energy of motion is greatest.

33. It is well known dynamically, as a property of all known motion, that the energy of such motion in a given mass varies as the square of the velocity, so that, by analogy, if magnetic flux density corresponds to ether velocity, we should expect that the energy associated with magnetic flux should increase with the square of its intensity. This is experimentally found to be the case. Thus if $\mathcal{B}$ represents the intensity of magnetic flux, expressed in gausses, then the energy in every cubic centimetre of space, except in iron or other magnetic material, i. e., in the ether permeated by such intensity, is $\frac{\mathcal{B}^2}{8\pi}$ ergs. Thus, if a cubic inch of air (a volume ot 16.387 cubic centimetres), be magnetized to the intensity of 3,000 gausses, the energy it contains, owing to its magnetism, will be

$$\frac{16.387 \times 3000 \times 3000}{8 \times 3.1416} = .5868 \times 10^{7} = 0.5868 \text{ Joule.}$$

34. Just as in the electric circuit, the presence of an electric current necessitates the existence of an E. M. F. producing it, so in a magnetic circuit, the presence of a magnetic flux necessitates the existence of a magneto-motive force (M. M. F.) producing it. We know of but two methods by which a M. M. F. can be produced, viz.:

(1) By the passage of an electric current, the neighborhood of which is invested with magnetic properties, i. e., surrounded by magnetic flux;

(2) As a property inherent in the ultimate particles of certain kinds of matter, possibly the molecules, of the so-called magnetic metals.

The passage of an electric current through a long, rectilinear conductor, is attended by the production of a magnetic field in the space surrounding the conductor. The distribution of flux in this field, is a system of cylinders concentric to the conductor, and is directed clock-wise around the conductor, if the current be supposed to flow through the clock from the face to the back. This distribution is shown in Figs. 26, 27 and 28. Fig. 26 (p. 231) represents the distribution as obtained by iron filings. The density of the flux is roughly indicated by the density of the corresponding circles.

35. Fig. 27 shows the geometrical distribution of the flux paths around a wire carrying a current, which is supposed to flow from the observer through the paper. Here a few of the flux paths are indicated by the circles, 1, 2, 3, 4 and 5, while the direction is shown by the arrows. The distribution of the flux is such that it varies in intensity inversely as the distance from the axis of the wire, and the total flux between any adjacent pair of circles is the same; for example, the same between 1 and 2, as between 4 and 5, or in the hydraulic analogy, the total flow of water per second between any pair of adjacent circles is the same, as across the boundaries 2, 3, or 4, 5, the velocity diminishing as the distance from the axis of the wire.

Fig. 28 represents the direction of the flux round the active conductor, the current flowing from the observer through the shaded disk.

(To be Continued.)

Electric Lighting in Great Britain—IV.

BY E. RAY STEVENS.

The number of electric light plants in the United Kingdom that are owned and operated by companies is slightly in excess of the number operated by municipalities. But the present tendency is toward public operation, and the balance will soon be in favor of public plants if some counteracting course does not intervene. We can form a somewhat better judgment of the success of private than of public operation because of the fact that more of the private than of the public plants have been operated for a period of three or four years.

The plant at Southampton has been in operation four years and in the first three years of that time performed the unusual feat of reducing the cost of light from 64.48 cents per unit to 8.64 cents, a little more than one-eighth the cost of production during the first year of operation; last year expenses had been so reduced as to leave a gross profit of $1,200, from which the company was for the first time able to pay interest. Last year the consumption was nearly 55,000 units, or almost eleven times what it was in 1891.

The company at Liverpool, which has operated its plant for but four years, made a gross profit of over $55,000 during the first year; last year it had reached $77,000. In the three years the plant had been extended sufficiently to increase the capital from $810,000 to $1,070,000. Last year $34,000, or over three per cent. of the total capitalization, was set aside for the sinking fund. The cost of coal per unit consumed was 1.92 cents in 1891 and 1.86 cents in 1893, an advance of .4 cent over the cost in 1892, caused by the scarcity of coal last year. The cost of all, carbons, etc., was .42 cents per unit in 1891 and .32 cents in 1893; wages cost .96 cents in 1891 and .76 cents in 1893. The cost of repairs and maintenance was 1.2 cents in 1891 and 1.28 cents last year. The total cost per unit, including taxes and cost of management, was 6.04 cents in 1891 and 5.72 cents in 1893. During the same period the average charge per unit had been reduced from 14.9 cents to 13.58 cents.

Among the more prosperous undertakings is that of the Westminster company, which last year supplied nearly three times the amount consumed in 1891. The gross profits have, during the same time, increased nearly four-fold, and were last year $92,000 on a

capitalization of $1,905,000. The cost of production and distribution has been lowered from 6.66 cents per unit in 1891 to 4.57 cents last year, while the total cost per unit was lowered from 10.64 cents to 6.88 cents during the same period, and the average price charged lowered from 14.44 cents to 11.86 cents per unit.

The company at Notting Hill has been operating its plant for four years, during the first two of which the gross revenues did not meet the total cost of operation. During the first year especially, the wages, salaries, maintenance and office expenses were very high. The consumption of the first year was but 30,000 units, but last year the number of units supplied to customers was over 100,000, which yielded a gross profit of 7,000. Last year for the first time the company was able to pay interest, but as yet nothing has during the three years of operation been written off for depreciation or set aside for sinking fund. The total cost per unit has been reduced from 24.66 cents in 1891 to 10.58 cents in 1893. During the same period there has been a slight reduction in the average charge, which was 16 cents per unit in 1891 and 15.64 cents in 1893.

These are representative examples and give a fair idea of the ups and downs of electric lighting companies in England. A comparison of the results attained by public and private operation, so far as these can be obtained at the present time, will be interesting and of value as well. In order to make the comparison of greater value, all plants whose operation was begun during the year 1893 will be omitted, as conclusions drawn from the results of the first year of operating a plant can have but a very slight value.

As far as figures could be obtained there was not found a single public plant that ran at a loss during the second or any subsequent year of its operation. While the company at Southampton failed to meet ordinary expenses during the first two years, the latest returns show that the companies at Preston as well as the London Electric failed to make expenses during both the years reported. All the city plants that have been operated more than one year have since the very first been able to pay interest, taxes, depreciation and sinking fund charges, while there are four companies that have not paid interest during the first one or two years of operation, but all are now meeting this charge. There are also ten companies that have failed during one or more years to set side a sum for depreciation and sinking fund. Three of these companies which were established in 1892, failed to meet that charge, either in that year or during last year, and one company, established in 1891, has not met the charge in any of the three years.

The tendency has been to largely reduce the cost of production per unit consumed. It was lower in all plants last year than during the first year of their operation, with the exception of those operated by two different private companies. As a rule the average charge for service was lower last year than when operation was begun. To this there are five exceptions, four private companies and one public plant.

Perhaps the best way of summing up the figures that are at hand will be to give the averages of all that are available. In finding the cost of light, the average of which is given in the first line, interest, dividends, depreciation and sinking fund contributions have been excluded, because of the fact that they are fixed in an arbitrary way and vary greatly in different cities, but taxes, wages and all other expenses of operation and management are included. In the second line the average charge in each city is used. The gross surplus is in each case the difference between one hundred per cent. and the percentage of the total cost per unit to the total revenue per unit. All the figures taken apply to the year 1893 alone.

Items Compared.	Private.	Public.	Difference.
Average actual cost per unit......	8.35c.	6.06c.	2.29c
Average charge per unit..........	12.10c.	11.54c.	.56c.
Gross surplus....................	30.22 p. c.	50.28 p. c.	20.06 p. c.

It should be added that these averages deal with commercial lighting alone. Few cities have as yet replaced gas by electric light as a means of illuminating their streets and public places. This table shows that, considered both from the standpoint of the consumer and of the manufacturer, the municipalities of Great Britain are fully as successful in operating their plants as are private companies. Their gross surplus is two-fifths greater than that of the companies, while the average cost of manufacture is about three-fourths. There is also the saving of a half cent per unit to the consumers where the city owns and operates the plant.

Action of a Transformer with a Condenser in Parallel with the Secondary—III.

BY FREDERICK BEDELL AND ALBERT C. CREHORE.

EFFECTS OF A VARIATION OF THE CONDENSER CAPACITY WHEN THE PRIMARY CURRENT IS CONSTANT.

We are now prepared to construct the diagram to represent a transformer supplied with a constant primary current, the circuit being that of Fig. 1, when the condenser capacity is varied.

Referring to Fig. 9, let OA represent the constant primary current; OB, equal to $M\omega I_1$, and 90° behind the primary current, is the constant impressed electromotive force in the transformer secondary. Take OB′, Fig. 5, as the selected value of the secondary E. M. F., which is to be kept constant. This is made equal to OB Fig. 9. When the condenser capacity is zero, we have the parallelogram $OC_1BC'_1$, Fig. 9, equal to $OCB'C'_1$, Fig. 5; and so OC_1; OD_1, and OQ_1, are lines in Fig. 9 that correspond with OC, OD, and OQ_1 in Fig. 5, and these are values of corresponding quantities when the condenser capacity is zero, or when the condenser is absent. Lay off OS, Fig. 9, so that the angle BOS equals arc tan $\frac{L_2\omega}{r}$ equal to the angle COC'_1, Fig. 5, which OC makes with the perpendicular upon the line BB′. Then will OS be the *direction* of the diameter of the circle upon which OC varies, according to the previous theorem, and, since one point C_1 on the circle, is determined, this determines the circle C_1SCO which may now be drawn. OC is any position of the variable. The resultant of OC, the con-

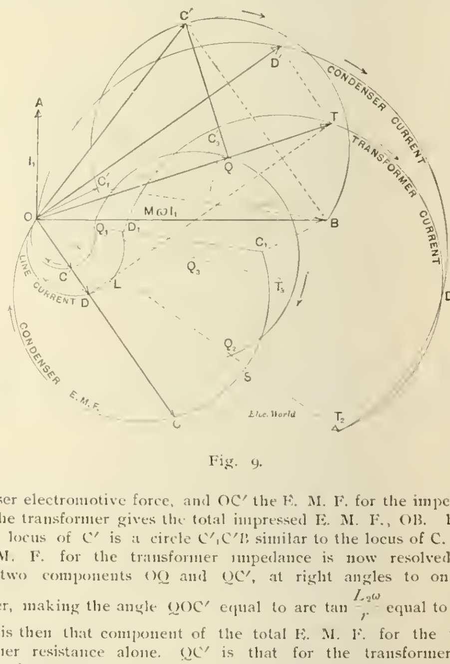


Fig. 9.

denser electromotive force, and OC′ the E. M. F. for the impedance of the transformer gives the total impressed E. M. F., OB. Hence the locus of C′ is a circle $C'_1C'B$ similar to the locus of C. The E. M. F. for the transformer impedance is now resolved into its two components OQ and QC′, at right angles to one another, making the angle QOC′ equal to arc tan $\frac{L_2\omega}{r}$ equal to BOS. OQ is then that component of the total E. M. F. for the transformer resistance alone. QC′ is that for the transformer self induction. OQ has the direction of the transformer current OT, and is equal to OT divided by the transformer resistance r. Hence we have one position of the transformer current OT, which corresponds with the position OC of condenser E. M. F. Since the current OD through the line is proportional to the E. M. F. at the condenser terminals, OC, and equal to it divided by the resistance R, the locus of OD is a circle similar to OCS upon OL as diameter. And, since OT the transformer current is the geometrical sum of OD the line current and OD′ the condenser current, we have OD′ equal and parallel with DT.

It is evident that the locus of OQ is the circle Q_1QQ_2 having a centre Q_3 situated so as to make C'_3OQ_3 a triangle similar to $C'OQ$; as C′ moves around its circle the point Q always lies behind it by an angle arc tan $\frac{L_2\omega}{r}$ and when C′ arrives at B, Q arrives at Q_2 upon the line OS. The centre Q_3 of this circle is similarly situated behind C'_3 the centre of the other circle, as the points in the cir-

cumference are so situated. Likewise the locus of OT is a circle D_1TT_2 similar to Q_1QQ_2 having its centre at T_3 so that OT_3 equals QQ_3 divided by r. Having the loci of T and of D, that of D′ is found since OT is always the resultant of OD and OD′. The locus of OD′ the condenser current is the circle $OD'D'_1T_2$ upon OD'_1 as diameter, which is OC_1 prolonged. That the diameter has this direction appears from the following: OD′ is always at right angles to OC, but when OC coincides with OC_1, the condenser current is zero and OD′ starts out at the origin perpendicularly to OC_1. Hence the diameter has the direction of OC_1. The circle passes through T_2 because the transformer and condenser current coincide when the capacity is infinite, inasmuch as either current is very large compared with the line current OD at this point. When the capacity is infinite, it is equivalent to short circuiting the transformer by a stout wire so that no current will pass through the line. In this case the diagram becomes simple and the triangle of electromotive forces is as usual OBQ_2 so that BOQ_2 equals arc tan $\frac{L_2\omega}{r}$, and OT_2 equals OQ_2 dvided by r.

Having obtained the current OT through the secondary of the transformer, the back E. M. F. and primary E. M. F. are readily obtained by methods discussed in previous papers. The construction for this is omitted from the diagram to avoid complexity. The reaction of the secondary upon the primary will be taken up later.

DIAGRAM FOR ACTUAL TRANSFORMER WHEN THE CONDENSER TERMINALS HAVE A CONSTANT POTENTIAL DIFFERENCE, AND THE CAPACITY IS VARIED.

In practice there is a modification which amounts to a simplification that enters into the construction of this diagram. The transformer inductance is usually very large as compared with the internal resistance so that the angle arc tan $\frac{L_2\omega}{r}$ is almost ninety degrees.

Take the particular example of the constant current transformer considered in the previous papers, viz.: that for which the constant current polar diagram is given in Article IV, Fig. 9.* The data for the transformer is as follows: $L_1 = .032$ henrys, $L_2 = .016$ henrys $R_1 = .227$, $r_2 = .16$ ohms. $\omega = 1000$. A calculation gives,

$$\frac{L_2\omega}{r_2} = \frac{.016 \times 1000}{.16} = 100.$$

Hence, arc tan $\frac{L_2\omega}{r_2} = 90°$ approximately.

To draw the actual diagram, Fig. 10, corresponding to the typical diagram, Fig. 5, take OC arbitrarily equal to 150 volts. Let the

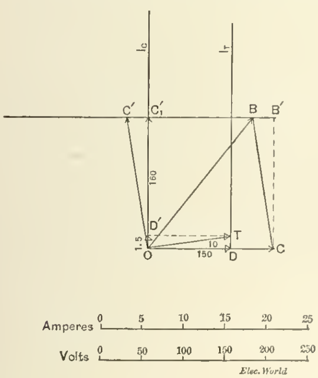


Fig 10.

line resistance R be 15 ohms, a rather high value. Then OD equals $150 \div 15 = 10$ amperes. The condenser current OD′, varies upon the line I_c and the transformer current upon I_t. When the condenser capacity is ten microfarads, the condenser current, $C\omega$ times OC, is equal to $1000 \times 150 \times 10^5 = 1.5$ amperes, and is represented by OD′. This gives the transformer resultant current OT a trifle more than ten amperes.

When the condenser capacity is zero, T coincides with D, and the impressed E. M. F. to drive this current through the transformer is $L_2\omega$ times the current OD, and is 90° in advance of it. $L_2\omega \times OD = .016 \times 1000 \times 10 = 160$ volts. Hence OC_1', ninety degrees in advance of OD and equal to 160 volts, is the E. M. F. for the transfromer impedance. Since the E. M. F. OC′ is always 90° in advance of OT and equal to $L_2\omega$ times OT, the locus of C′ is the line $C_1'C'$ at right angles to OC_1'. The transformer impressed E. M. F., OB has for its locus BB′ in the same straight line with $C'C_1'$. This evidently corresponds completely with the diagram Fig. 5, when the angle COC_1' becomes 90°. The lines BB′ and $C_1'C'$ beome one and the same straight line parallel with OC.

THE ACTUAL TRANSFORMER DIAGRAM FOR CONSTANT PRIMARY CURRENT, WHEN THE CAPACITY IS VARIED.

The typical diagram, Fig. 9, representing a general case is likewise modified in the actual case supposed, since the angle C′OT

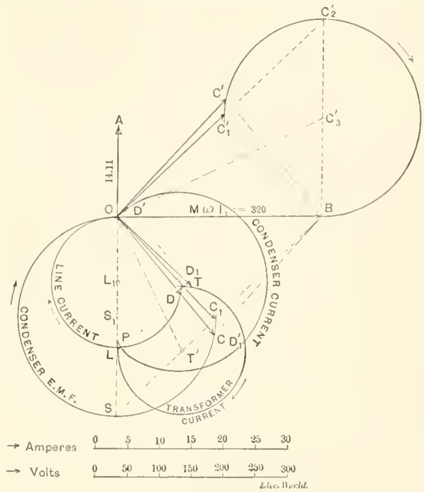


Fig 11.

becomes approximately a right angle. Let OA, Fig. 11, represent the primary current of 14.17 amperes supplied to the transformer, the data of which appears above. Then the impressed E. M. F., OB upon the secondary is 320 volts. When the condenser capacity is zero we have a rectangle OC_1BC' upon OB as diagonal similar to that in Fig. 10, viz: $OCB'C_1'$. The angle BOC_1 is arc tan $\frac{L_2\omega}{r + R}$ and in the case supposed is

$$\text{arc tan } \frac{.016 \times 1000}{.16 + 15} = 46°.5 \text{ approx.}$$

The circle OSC_1 here has its diameter OS at right angles with OB; and since C_1 is a point on the circle, the length of the diameter OS is found by drawing a line from C_1 perpendicular to OC, until it intersects the perpendicular to OB in S. This line C_1S is then the line BC, prolonged to S. The locus of OC′, the E. M. F. for the transformer impedence, is now determined by a circle upon BC_2' as diameter parallel with OS and symmetrically situated with respect to OB. The locus of OD the current through the line is a circle OLD upon a diameter OL having the direction of OS and equal to OS′ divided by R. The condenser current, being always at right angle in advance of the E. M. F., OC has for a locus a circle $OD'D_1'P$ whose diameter OD_1' has the direction of OC, as explained in Fig. 9. The resultant or transformer current is determined by the two component currents already drawn; but it is a circle whose center T′ is on a line at right angles in this case behind the center C_3' as explained in Fig. 9.

(To be Continued.)

Care in the Use of Terms.

An esteemed contemporary, in an editorial, calls attention to the confusion which is caused by the incorrect use of terms, but in the same editorial it makes use of the term "bad magnetic air," evidently meaning air which has poor magnetic qualities; as it reads, it would mean bad (impure) air which is magnetic. Further-

* See The Electrical World May 27, 1893, page 391.

more, while air may, in a theoretical sense, be considered magnetic as distinguished from dia-magnetic, yet in practice it must surely be considered as non-magnetic, and it therefore does not seem advisable to call it magnetic, any more than to call copper an insulator of poor quality.

The American Electrical Works' Clambake.

The sixteenth annual clambake of the American Electrical Works was held at the beautiful Haute Rive last Saturday, August 25, and was attended by nearly 200 members of the electrical fraternity from all parts of the country. The weather was typical "clambake" weather. Most of the visitors went from Providence to the rendezvous per electric cars, and as fast as the various contingents arrived the fun and frolic began in right good earnest. President Eugene F. Phillips, Mr. W. H. Sawyer, Messrs. Hathaway, Ackerman, Carroll and Donohue, all colleagues of Mr. Phillips, were on hand to welcome the guests. All regretted the enforced absence of Mr. Remington, who is just recovering from a serious attack of typhoid fever.

As soon as lunch had been partaken of, a baseball game was arranged between Boston and Providence teams, which resulted, after some fine playing, in Boston winning 26 to 6.

The usual round of amusements and pastimes was provided and enjoyed. During the kicking of the football, Mr. Donohoe had the misfortune to fall and strain one of the ligaments in his right leg rather severely. The artist was on hand, as usual, and secured good line shots at the party. The "bake" proper was as appetizing as ever, the seat at the head of the table being occupied by Mr. Eugene F. Phillips. Mr. C. W. Price, of New York, acted as toast-master, and the good things having been dispatched with alacrity, several brief but enjoyable addresses were delivered. The first speaker was Mr. J. C. Wyman, of Valley Falls, who was listened to with closest attention as he recounted how little he knew of the wonderful science, the representatives of which were present, and which was accomplishing so much for the world at large and would accomplish so much more in the future.

Mr. John I. Sabin, the well-known and popular telephone manager, and a life-long friend of Mr. Phillips, was present from San Francisco; he was the first who suggested the holding of these annual clambakes, and his remarks were cordially received.

Mr. Hibbard, manager of the Chicago Telephone Company, greatly entertained the company by singing a pleasant little ditty about a Sabbath-school pupil who always did as he was told.

Mr. Brown, of the Newburyport and Amesbury Electric Railway, briefly responded to a call for a speech.

After this the sports were resumed until evening, when a start was made for Providence, every one of the clam-eaters voting the occasion one of the pleasantest days ever spent together.

Storage Battery Litigation.

Judge Green, of the United States Circuit Court of the District of New Jersey, in his recent decision denying the motion of the Brush Electric Company for a preliminary injunction against the Electric Storage Battery Company, gives two grounds for his action. One is based upon the lack of necessary proof to show that the chloride accumulator infringes the Brush patent, and the other on the affirmation of inexcusable delay in bringing suit.

The complaint states that the validity of the Brush patent in question is beyond dispute, having been sustained by all the courts before which it has been the subject of litigation. The only question, therefore, to be considered upon the motion made, under the circumstances, is that of infringement, and the proof of alleged infringement must be clear and decisive. In the present case the court declares that the proof fails to attain this standard.

The opinion refers to the depositions of Professors Brackett, Cross, E. Thomson and Mr. Van Size for the complainants, as expert evidence entitled to great weight, and which assert quite positively that not only the storage battery manufactured by the defendants, but the process as well infringe, some if not all of the claims of the patent under consideration. These opinions, however, according to the court, rely for their justification, first, on the Brush patent and the various claims being given an exceedingly broad construction, and second, on such broad construction being based upon a yet broader one of the legal conclusions of judges who have in past litigations defined and characterized the inventions of Faure and Brush. On the other hand, Professors Morton, Chandler, Houston and Barker, who are declared equally as learned and of equal standing and repute in the scientific world, have presented antagonistic opinions, in which they most distinctly and positively declare that neither the process pursued by the defendants nor the completely manufactured battery infringe in the slightest degree on the cells of the plaintiff.

When, the court declares, the statements so made and the opinions so expressed come to be tested by severe and thorough cross examination, those which show themselves securely founded upon reason and fact will be immediately accepted and concurred in; but until then, the existence of a doubt through this difference of opinion is well founded and reasonable aid cannot be overlooked. This doubt is fatal to a motion for a preliminary injunction, as the immediate and threatened infringement of the right must appear as clear as the noonday sun.

In regard to the question of great diligence in the assertion and vindication of the complainants' rights, without which they will be shorn of any right to appeal for assistance, the court states that the case submitted shows that the dilatory conduct of the complainants in protecting their rights amounted to open encouragement, or, at least, silent acquiescence in their invasion, and such conduct debars absolutely the relief asked for at this time by the complainants.

In the opinion the history of the defendant corporation is given. It was organized under the laws of New Jersey in 1888 to manufacture and sell the chloride accumulator, and from the time of its incorporation it has openly and to the knowledge of the complainants carried on its business without interruption to the present. Reference is made to a pamphlet issued early in 1893 by the defendants, and widely circulated, containing an opinion of Professor Chandler, which goes at length into the details of the chloride battery, comparing it with the battery of the complainants and strongly asserting there can be no infringement. A letter written in July of the same year by the president of the Chloride Accumulator Company to the complainant company is quoted, in which infringement is denied and a demand made that the charge of infringement should either be sustained in court or suit for damages would be instituted. In the meantime the defendants, justifiably assuming that no attack was to be made upon them, increased their capital stock $250,000 and proceeded to erect an addition to their existing plant at a very large cost, and it was not until 1894, a number of months afterwards, that this present bill of complaint was filed.

The complainants alleged that their delay in bringing action was due to the time spent in making a diligent search for some purchaser of defendants' battery within the district of the United States Circuit Court for Southern New York, as in that district much of the previous litigation concerning the Brush and Faure batteries had taken place; further, that all the operations of the defendant were considered to be tentative and therefore not of a kind to justify a suit costing many thousands of dollars. The court decides that such excuses do not justify the delay of which the defendants have been clearly guilty. The result of their inaction is found in the increase of capital stock of the defendant and the expenditure of a large amount of money in the erection of a new plant. Upon the argument it was admitted that the defendant was financially responsible and amply able to respond to any award of damages that might be made against them. Under all the circumstances and for the reasons given the court therefore denied the motion for a preliminary injunction.

Cost of Producing Electrical Energy.

To the Editor of The Electrical World:

Sir:—In the issue of Aug. 4 of your esteemed journal, I noticed, in an article by Mr. B. J. Arnold, a statistical table concerning German central stations, with whose compilation Mr. Laffargue of Paris is credited. This table, of which Mr. Arnold says "that it is the most complete information regarding foreign central stations," was, however, not worked out by the above named gentleman, but by me, being based on material laboriously collected. Mr. Laffargue has confined himself to reprinting it from the "Elekto-technische Zeitschrift" in "L'Industrie Electrique," No. 57, with my consent, and with the express mention of my name.

Max Meyer.

Nüremberg, Germany.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Leyden Jar Discharges.— A British Association paper by Lord Kelvin & Mr. Galt on "Preliminary Experiments for Comparing the Discharges of a Leyden Jar through different Branches of a Divided Channel" is given in abstract in the Lond. "Elec. Eng." and Lond. "Elec. Rev." August 17.

A New Discharge Phenomenon.—According to the "Zeit. feur Elek.", July 15, Mr. Pilschikow observed that when the positive pole of a Voss machine is connected with a metallic point and placed over a vessel containing castor oil connected with the negative pole, a depression will be formed in the surface of the oil below the point; a screen placed between the point and the surface will cause the opposite effect, being similar to a shadow of the screen, the point being the source of light; the same takes place when the point is made the negative pole. A reference to what appears to be the same phenomenon was given in the Digest May 12.

Mechanical Effect of Electric Waves.—The article by Mr. Lebedew, mentioned in the Digest August 25, is abstracted more fully in the "Elek. Zeit.", August 16.

Explanation of the Ferranti Phenomena.—"The Zeit. feur Elek.," August 15, reprints a paper by Dr. Sahulka, in which he gives a mathematical and an experimental proof of the fact that the phenomena is due to the so-called magnetic leakage in the transformer; the same paper was abstracted in the Digest January 20.

Formation of Floating Metallic Films.—The Lond. "Elec. Eng.," August 17, abstracts briefly a paper by Messrs. Mylius & Fromm from the "Ann. Phys. Chem."

Atmospheric Electricity.—A paper on "The Electrics of the Atmosphere" by Mr. Walker, is published in the Lond. "Elec. Rev.," August 17. He quotes from different sources and mentions observations of his own; he states that there is in the electric state of the atmosphere a condition which must so profoundly affect the health of the people that we cannot afford to postpone its thorough investigation; he believes that there is no doubt that in much that has been written and discussed in the past, observers have been unintentionally confusing different causes and effects.

A British Association paper by Lord, Kelvin, Messrs. Maclean & Galt, is published in abstract in the Lond. "Elec. Eng." and Lond. "Elec. Rev.," August 17; the title is "Preliminary Experiments to find if Substraction of Water from Air Electrifies It." The experiments do not seem to be conclusive.

Flowing Electricity.—A publication by Dr. Stricker & Mr. Deutike is noticed in the "Zeit. feur Elek.," July 15, and appears to be recommended highly to those who are interested in theory as well as in practice. They appear to prove that in every closed circuit there exist two currents flowing in opposite directions, one a current of positive and the other a current of negative electricity, each flowing with gradually reducing tension and intensity. Among other things they state that Volta's fundamental experiments depend not on the contact but on the approaching or receding of the heterogeneous metals, the source of the current being the mechanical work exerted by the experimenter; they claim that the ions do not migrate through the whole electrolyte; their deductions appear to be based on experiments.

MAGNETISM.

Terrestrial Magnetism.—A British Association paper by Prof. Schuster, is published in full in the "Lond. Elec.," August 17; the subject is "A Suggested Explanation of the SecularVariation of Terrestrial Magnetism." He states that it is important to ascertain whether we must consider interplanetary space to be a conductor of electricity or not, and the object of his paper is to give some numerical calculations referring to the magnitude and nature of the reactions which would follow such a conductive property; the results of his investigations are that the mechanical reaction on the earth of currents induced in space, are insufficient to produce an appreciable lengthening of the day in historic times, unless the conductivity lies within certain narrow limits; and the magnetic reaction of the same current, in conjunction with the secular cooling of masses of iron inside of the earth, tend to produce a displacement, which is the same in kind as that observed in the secular variation.

The British Association paper of Prof. Rucker is abstracted briefly in the Lond. "Elec. Rev.," August 17.

Manganese Steel.—In an Academy note by M. Le Chatelier, published in "L'Ind. Elec.," August 10, he gives the results of some experiments with manganese steel made of an alloy of iron with 13 per cent. of manganese; this metal is not magnetic and has the highest resistivity of any alloy of iron, it being about one ohm per meter for one mm. in diameter; there is an allotropic property of this alloy which is magnetic; he describes how one form may be changed into the other by means of heat; the resistance of the two varieties is given for different temperatures showing that the two curves meet at 750° C, which is the same temperature as that at which soft iron passes from the magnetic to the non-magnetic state.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Simple Electrical Method for Testing Dynamos and Motors.—In the "Zeit. feur Elek.," July 1, Mr. Lenz describes a method for testing a dynamo or motor without the use of a dynamometer or a duplicate machine as in the Hopkinson method, and without the assumption that the efficiency of motor and dynamo are the same; it is a purely electrical method in which none but electrical measurements need be made. The description is not very clear and does not appear to be quite correct; the following is a translation of the essential parts. The motor is first run unloaded and the required watts L_m are measured; it is then coupled mechanically with any convenient dynamo; a second measurement of the energy required by the motor is then made while the field of the unloaded dynamo is excited; the exciting current of the dynamo need not be known but should merely be kept constant; deducting this from L_m gives the power L_d in watts, which is consumed in the motor to overcome the passive resistances and the hysteresis losses in the dynamo; this loss, as also the measurement in the first test, can be taken as constant for the same speed and the same excitation; a third set of tests is then made with different loads on the dynamo; the excess of power used in the motor, that is, after that in the second test has been deducted, is designated by L_e, the energy generated in the dynamo (it is not quite clear what is meant here), including the C_2R loss in its armature, is designated by L_e, and the quotient $L_e \div L_z$ is designated by E with subscripts for the various loads; on a system of co-ordinates the abscissas are made equal to $L_m + L_d + L_z$ and the corresponding co-ordinates $L_e \div L_z$, forming a curve which is nearly a straight line parallel to the abscissas, especially so for small loads; if E' is the value (of what?) corresponding to the smallest loads and if this be made equal to E_e for $L_e = O$, an assumption which the parallelism of the curve admits, that is, if it be made equal to $L_e = L_z$, for the dynamo when not loaded, then the electrical equivalent of the mechanical power delivered by the motor in the second test becomes known; if the above assumption that the ratio of the various values of the quotients $L_e \div L_z$, are equal for two loads not differing greatly from each other is correct, then L_d, $E_o = L_x$; the correctness of this assumption is proved by the curve; from these measurements the efficiency of the motor for each of the loads can be determined, as the power absorbed by it is equal to $L_m + L_d + L_z$, and the power delivered by it is L_d, $E_o + L_e$, the efficiency being therefore their quotient of the second divided by the first. For testing a dynamo it must be driven by a motor, for which the $L_e \div L_z$ curve is determined as described above; it is not necessary to determine the loss in the armature when only the efficiency is to be measured. For machines of small power, as for instance, ventilator motors, this system is said to be especially applicable; if, for instance, a one h.p. motor is tested with a dynamo of 100 to 200 watts, the power for no lo d and the power delivered can be measured with great accuracy with electrical measuring instruments. He calls attention to the fact that great care must be taken with the measurement of the speed, as the power at no load can readily be changed 15 per cent. merely by the pressure of the speed indicator.

Graphical Calculation—A British Association paper by Mr. Trotter on "A Graphical Transformer," is published in full in the Lond. "Elec." and Lond. "Elec. Rev.," Aug. 17; it is intended for replotting a curve with transformed ordinates, without calculation or scaling and consists of a retangular frame, a curved template and a straight rule. He also shows how it can be used for obtaining the product or quotient of two curves by adding or substracting the logorithms of the ordinates.

Construction of Delicate Galvanometers.—A British Association paper by Mr. Schuster is abstracted in the Lond. "Elec. Eng.," Aug. 17; he compares the theoretically best way of winding the coils with that in which the coils are rectangular, both with uniform wire and wire of increasing diameter, obtaining the figures 1.60, 2.14 and 2.00 respectively for the three methods, the figures being proportional to the smallest current; he concludes that the advantage gained by winding in the theoretically best manner is therefore not very marked.

Instruments for Instruction.—An article in the "Elek. Echo," July 28, describes and illustrates a number of such electrical instruments; a new

form of galvanometer for lecture purposes is described in the issue of Aug. 4.

Test of Dry Cells.—The Lond. "Elec. Rev.," August 17, publishes in full a recent report of Prof. Jamieson on some tests made with the Obach and the E. C. C. cells, the dimensions of the two kinds of cells being about the same. The report contains a number of tables of the observed data; they demonstrate in most cases the superiority of the Obach cell. In an editorial discussion it is stated that the report is useful in showing how tests of that kind ought to be carried out; it endorses the conclusion to use as a unit of comparison the bulk of the cells, stating that "no other tests than that of taking cells of a similar size can be really of value." (With the exception of comparatively few cases, the user of such cells is concerned with the relative costs and behaviors of the cells, their bulk being of very little importance to him, as the space occupied by such cells is generally of little consequnce; it would seem therefore that the price and not the bulk would form a better unit of comparison).

DYNAMOS AND MOTORS.

Cast Steel and Cast Iron for Dynamos.—In an article by Mr. Schultz in the "Elek. Echo," Aug. 11, he calculates two dynamos differing only in the field magnet frame and field winding, in one of which cast iron is used and in the other cast steel. From curves he shows that with cast steel 12,000 lines of force per square centimeter (12 kilogausses) can be used and for cast iron 6,000, the former requiring 6.4 ampere-turns and the latter 28 ampere-turns per centimeter length of magnetic circuit; his calculations show that 5,800 ampere windings would be required for the cast iron as against 3,330 for the cast steel magnets. His conclusions are that the weight of the magnet frame will be reduced to one-half, and the weight of the copper for the magnets to somewhat less than one-half, in the cast steel magnets; the price of the steel is about twice as great, but on account of the reduction in the amount of copper the machines will be cheaper; he adds that there is a disadvantage in that cast steel is of such widely differing qualities and can therefore not always be relied upon without special testing.

ARC AND INCANDESCENT LIGHTS.

Ignition Produced by Incandescent Lamps.—A number of experiments are cited in a note in the "Zeit. feur Elek.," July 15; when covered with a layer of explosive powder, changes take place in the powders, some of them losing their sulphur, but none being ignited; the heating effect is increased by the proximity of heat non-conducting materials; when the lamp cracks or is broken, there is claimed to be considerable danger as it will ignite a mixture of explosive gases, although it will not ignite gunpowder; it is concluded that there exists a possibility of danger and it is therefore not safe to bring lamps too near to combustible materials.

Electric Lighting from Balloons.—According to "L'Elec.", Aug. 11, the German Government is experimenting with this system for the lighting of battlefields or districts for military manœuvers; a light of 5,000 candles is said to be sufficient to light an area of about 500 meters in diameter in a hazy atmesphere, the light being 600 meters high; the source of the current, which is on the ground, is connected by cable with the balloon; the experiments were satisfactory and it is probable that the system is being used at the present manœuvers.

Etching Glass Bulbs.—The "Elek. Anz.," July 29, gives the following receipt: 36 grams sodium fluoride dissolved in one-half litre of distilled water after which 7 grams of potassium sulphate are added; a second solution is made of 14 grams of zinc chloride dissolved in half a litre of distilled water to which is added 65 grams concentrated hydrochloric acid: both liquids may be kept in glass bottles; to use them, equal volumes of the two liquids are mixed in a hollow block of paraffine to which some India ink is added to make the design visible; it is stated that the finest hair lines can be etched with this liquid.

Leading-in Wires.—The "Elek. Anz.," Aug. 2, states that an alloy of 25 parts of tin with 5 parts of copper has the same expansion co-efficient as glass and can be fused to the glass; the addition of ½ to 1 per cent. of lead or zinc will make the material softer or harder.

Lamp Shades.—The Lond. "Elek. Eng.," Aug. 10, mentions that a London firm is introducing some artistic shades made of natural feathers dyed and arranged in artistic combinations; they are illustrated in the Lond. "Elec.," Aug. 17.

ELECTRIC RAILWAYS.

Douglas-Laxey.—A brief description of this railway is given in the Lond. "Elec. Eng.," and Lond. "Elec.," Aug 17, several illustrations being given in the former. One of the interesting features is in the use of a batch of 24 cells of accumulators placed near the line several miles from the station; it is charged directly from the line, or from a motor generator of special design which gives the required additional pressure; it not only gives the extra power required at times of maximum demand, but during the winter months it is intended to run all the cars, being charged only once or twice a week as occasion may require. Instead of the trolley wheel the current is collected by two horizontal bars the width of the car, one being placed at each end; they take the current by rubbing against the wire. The line was designed by Dr. Edward Hopkinson. (Some further information is given elsewhere in this issue.)

European Electric Railways.—The Lond. "Elec. Eng.," Aug. 10, begins a summary of data regarding European electric railways, beginning with that at Aix-la-Chapelle and at Hamburg.

Trolley Lines.—A paper by Dr. Rasch is published in the "Zeit. feur Elek.," July 15 and August 1; he discusses a number of calculations regarding motors, regulatiou, etc., giving simple formulas.

Double Trolley System.—The Lond. "Elec.," Aug. 17, reprints from an American journal a paper by Mr. Perry, and in an editorial comment appears to advocate the double trolley system

Budapest Underground Railway.—According to the Lond "Elec." Aug. 7, the concession for the construction of this line has been granted; it is to be opened April 1, 1896, and will be two miles long.

Mont Salève.—An illustrated description of this electrical mountain road is published in "La Nature," July 7

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Some Advantages of Alternating Currents.—A British Association paper by Prof. P. S. Thompson is reprinted in full in the Lond. "Elec. Eng.," August 17. A full abstract of this paper will be found in The Electrical World of September 1.

Various Methods of Charging for Current.—In an article by Mr. Gibbings, in the Lond. "Elec. Rev.," July 27 and August 3, he calls attention to the fact that the success of a station will depend very largely on the method of charging, and discusses in detail the various methods which have been used and proposed. Omitting the system of a definite charge per year per lamp, he divides the methods into three, discussing each in detail. The first consists of separate charges for lighting current and for motive power, registered by separate meters; it is not an economical arrangement, as the lights may be used in the daytime and the motors during the time of maximum demand; double meter rental must be charged and there is no inducement to the public to use current for lighting in the daytime; the advantages are that the consumer knows the actual price and that the lower price for motive power induces the use of electricity for that purpose. In the second method there is one general charge with rebates on a large consumption; he states that no one system must, or probably will be, the best everywhere, as the character of the district makes a great difference; among the arrangements for rebates are (1) a rebate deducted from the last quarterly payment and based on the annual bill; a scale of rebates corresponding to a table of units for each lamp installed; (3) a combination of these two; (4) a maximum price up to a total equal to a consumption of 8 units per 8 c. p. lamp wired and a minimum price for every unit above this; (5) a sliding scale charge per unit on the absolute number of units consumed. The fist and second must be combined in order that there may be a legitimate basis for granting a rebate; the peaks in the load line may be due to the very customers who get the largest rebates and who consequently pay the smallest price per unit, but with the combination of the two systems some guarantee is assured that the demand is used for a considerable time per day; but it does not encourage those who use current during the day only; the fourth arrangement is similar but simpler and is claimed to be very satisfactory in a station in which it is used: it has the tendency to eliminate a most undesirable class. The third general method is to have a maximum charge based on the number of hours during which the demand is used, all excess being charged at a half or a different rate; the Wright system, which belongs to this class, is discussed; it consists in placing a recording ammeter in series with the consumer's meter, which registers the maximum amount used at any given time; it induces the consumer to use the greatest number of units for the smallest amount of current, thus effecting his own reduction; it tends to increase the day load, as it induces the consumer to use the current for motive power and other work during the day; consumers are all on an equal basis, whether their demand is large or small; the disadvantages are that it does not guarantee at what time of the twenty-four hours the number of units are consumed for which the full price is charged; it is unfair that he should be charged the lower rate if the current is used during the time of heaviest demand; the greatest disadvantage, and a very serious one, is that the indicator registers the absolute maximum demand at any one time; if for instance, the exceptional maximum is double, then double the number of units must be used throughout the year to effect the reduction; the method, however, approaches more nearly a perfect system than any of the others. He then discusses the charging in a general way, considering the cost at the works and the public interest, and offering a solution, he calls subsidiary charges those items which would not practically be increased by generating the remaining seven-eighths of the available output of a station in which one-eighth of the absolute capacity per year was used; those of the consumers who use current at the time of maximum demand, should pay for the net cost of generating the current, including all subsidiary charges, and in addition a minimum profit; the charge would be 10 cents per unit of one kilowatt-hour; those who require current at other times should pay the cost of generating, but not including the subsidiary charges; this he gives as 2.4 cts. per unit, to which he proposes to add the larger proportion of the company's estimated profits, which he gives as 3.6 cents per unit. In the conclusion in the issue of

August 10, he considers the attitude of the public to each of the three methods given; the first has the merit of being definite, but the demerit of being exceedingly unpopular; it is essentially the small consumer's system. The second system is wanting in definiteness, the consumer being in the dark as to what abatement he will have, and it is one sided, being satisfactory to the station but not to the consumer. Regarding the third system, he states that it would be satisfactory if it were possible to apply the system so that daily instead of quarterly records were taken. An ideal system should embody the following points: the charges per unit should be definitely fixed irrespective of the amount; records should be based on daily and not on quarterly consumption, the higher price should be charged only during the hours of maximum demand; these hours should be definitely fixed; no rebate should be allowed; only one pair of leads should be required; an automatic arrangement will be required to register the current consumed at the higher and lower prices. Under the ideal arrangement of such an apparatus he describes that suggested by Kapp, in which a clock controlled and rewound by means of Leclanche cells inserts or cuts out a shunt to the meter at the hours when the price changes, the shunt being calibrated by means of an amperemeter to conform to the ratio of the different prices; the device can be used with any existing meter and the original cost is said to be about $15 per consumer, in addition to which it is stated that it would be necessary to supply only those consumers who use the light for long hours.

Commercial Efficiency of Accumulators.—An article in "L'Ind. Elec.," August 10, gives the results of carefully kept records of the input and output of accumulators in constant use at the Clichy sector in Paris during the first five months of the present year. The battery consists of two sets of 250 cells each; the total weight of plates in a cell is 330 lbs., the normal output 250 amperes and the corresponding capacity 2,000 ampere-hours; the necessary increase in voltage for charging is obtained by means of a separate dynamo. A table is given containing the monthly charges and discharges in watt-hours and the efficiency for each month, the mean of which is 69 per cent.; there is an increase of efficiency every month, the efficiency for May being about 72 per cent.; the mean daily output is about 1,500 ampere-hours, which represents 75 per cent. of the capacity at the normal output, which output is often exceeded; the minimum output per day is 70 per cent. of its capacity.

Continuous Current Distribution at High Voltage.—A British Association paper by Mr. Parker is publised in full in the Lond. "Elec. Eng.," August 17; it is a description of the lighting of the city of Oxford; the generating station is situated 1,500 yards from the center of the lighting district; continuous currents of about 1,000 volts are produced and are transformed in 5 sub-stations by 7 motor transformers, which are said to be controlled by one man; a storage battery is installed at one of the sub-stations, supplying about one-twentieth of that load from one o'clock in the morning until an hour after sunset; it is charged from the mains with an additional motor generator which adds about 33 volts. Some detailed figures concerning the cost and output are given, among which it is stated that the total efficiency between the generated and the metered energy is 62.6 per cent.; the all-round efficiency of the transformers is 76.7 per cent. including the losses in the mains; the battery efficiency is 43.9 per cent.; the coal is 6.43 lbs. per kilowatt-hour sold.

Power Distribution Installation.—"L'Elec.," August 18, gives an illustrated description of an installation in a large factory in which the transmission by shafts and belts has been replaced by an electric system with individualom tors.

Arundel Castle.—The Lond. "Elec. Eng," Aug. 17, gives a brief description of this plant, which is said to be one of the largest private installations in the country; the illustrations show only the architectural features.

Accumulator Station at Eccles.—A report by Dr. John Hopkinson in which he recommends an accumulator station in that town, is published in the Lond. "Elec. Eng.," Aug. 17.

Manchester.—The switchboards at this station are illustrated and described in Lond. "Electricity," Aug. 3.

Train Lighting.—A descriptive article with some illustrations is given in the "Elek. Echo," Aug. 11.

Regulating Gas Engines.—In an article by Mr. Picou in "L'Ind. Elec.," Aug. 10, he discusses the various means used for damping the irregular action of gas engines when they are used for electric lighting; the variations in speed are at present still so great that they form a serious obstacle to the use of gas engines for lighting; the application of accumulators in derivation is not discussed. He gives the theory of an elastic transmission inserted between the gas engine and the dynamo and shows that this system is worse than nothing, as the irregularity in the running of the dynamo is thereby increased. In discussing fly-wheels, theoretically, graphically and by means of an example, he shows that their use is beneficial when they are placed on the engine, but that a limit to weight is rapidly reached; to place them on the dynamo will not remedy the evil entirely, as has often been supposed, their effect being then inappreciable; it is, however, not entirely useless. The only method at present in use which is effective is therefore to place a fly-wheel on the gas engine. He also suggests the use of the fly-wheel of Mr. Raffard, which has a variable inertia, as the masses of metal displace themselves readily against the action of centrifugal force, being retained by springs; for a given mass a much larger storage of power can thus be obtained for the same variation of velocity; the idea itself is not new. Another method which he suggests is the storage of part of the energy in a sort of spring, using, say the compression of air; curves are given for an engine with and without such a device.

The Hunting of Governed Engines.—A British Association paper by Mr. Swinburne is published in full in the Lond. "Elec. Eng.," Aug. 17

WIRES, WIRING AND CONDUITS.

Mechanical Calculation of Leads.—A simple and ingenious apparatus is described and illustrated in the "Elek. Echo," Aug. 4, for determining the cross section of leads for a given loss in volts or vice versa, for any groups of lamps at any distances; it consists essentially of a balance beam on which weights proportional to the number of lamps are hung at distances proportional to the actual distance of the lamps; the other end of the beam then indicates on a dial the required cross-section.

Wire Coupling.—In a note on the Arld coupling in the "Zeit. feur Elek.," Aug. 1, it is described as consisting of a sleeve, into which the ends of the wires to be coupled are run, after which the sleeve is twisted and the projecting ends bent over; experiments showed that there was no oxidization in the inner part of the tube; when subjected to tensile strength the rupture did not take place in the coupling itself; by making the tube large enough to slip over the insulated wire it can be used for making branch connections by flattening it, then inserting the branch wire and twisting it as before.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Signalling Through Space.—A British Association paper on this subject by Mr. Preece, is published in full in the Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Aug. 17. He discusses the subject in general and also the effect of the earth's conduction; he refers briefly to experiments across the Kilbrannan Sound, made between parallel lines on opposite sides, four miles apart, as also between loops 500 ft. high and five miles apart; he states that the distance to which the effective field formed by a coil extends, increases with the diameter of the coil more than with the number of turns of wire; among the different systems he finds that the best practical results are obtained with single parallel wires connected to the earth at each extremity, especially if the wires are carried to a considerable height above the sea, the earth plates being at the sea level, that system being better than the use of parallel coils or coils placed in the same plane; the question of the practicability of effecting communication he believes is now solved; he refers also to signalling across planetary space. In the appendix he gives a formula by Mr. Kemp for making calculations of such induction; in a second appendix a paragraph from "Nature," April 12, is given, referring to observations made on some lines during a recent magnetic storm of considerable magnitude.

Coast Communication.—According to the Lond. "Elec Rev.," Aug. 10, the Royal Commission who are examining systems of coast communication, have concluded that the "sunk" system, which has now been applied to the Goodwin and Kentish Knock lighthouses, is preferable to all the others.

Induction Telegraphy.—In an editorial in the Lond. "Elec. Rev.," Aug. 10, the article mentioned in the Digest, Aug. 25, is abstracted, but without comments. The issue of Aug. 17 contains a short article, giving, however, nothing new.

Production of Extra Currents.—An apparatus is described at some length and illustrated in the "Elek. Anz.," Aug. 9, for generating extra currents so that they can be used as alternating current impulses; the chief application is in telegraphy, in which one or two volts are used in place of a large number of cells for telegraphing to distances up to 160 miles.

ELECTRO-CHEMISTRY.

Preparing the Solution for Accumulators.—In an article by Mr. Sayers in the Lond. "Elec.", Aug. 10, he describes the preparation of four tons of acid; slate was used for the mixing tank, two days were allowed for the mixing and three days for the cooling; tests showed the presence of arsenic, which was eliminated by sulphurated hydrogen by a process which he describes. Whitening, he claims, is better for soaking up any spilled acid than soda, ammonia or sawdust.

Regeneration of Accumulator Plates.—The peroxide plates, after some usage, become soft and the material is apt to detach itself; to restore the oxide to its original state Mr. Epstein, according to La Lum. "Elec.," Aug. 4, dries the plates, then reduces the oxide by a negative current, then re-oxidizes them again by a positive current.

Bi-products with Useful Primary Batteries.—The "Elek. Echo," July 21, gives an article by Mr. Oppermann, in which he makes a number of suggestions for the construction of primary batteries whose bi-products are of value.

Electrolysis of Mixtures of Salts.—An article by Mr Houllevigue is abstracted at some length in "La Lum. Elec.," Aug. 4.

Electrolysers.—Those of Craney and Lienard are described and illustrated in "La Lum. Elec.," Aug. 4.

Chlorine and Soda.—According to the Lond. "Elec.," Aug 17, the Ger-

man Solvay Co. is about to use the electrolytic system for the production of caustic potash, chlorine and chlorite

Manufacture of Soap.—The Parker & Robinson process is briefly described in the "Elek. Anz.," Aug. 16; ordinary salt is electrolyzed, the fatty or oily material being brought in contact with the pole on which the alkali is set free; the soap thus formed floats and can readily be removed.

Manufacture of Varnish.—The "Elek. Anz.," Aug. 5, gives briefly the Pfann receipt in which pure linseed oil is mixed with water and sulphuric acid, and then subjected for two or three hours to an electric current passing from the vessel to the stirring apparatus; intimate mixing is essential.

Electric Tanning.—The Humy system is briefly described in the "Elek. Anz.," July 29.

Nickel Plating Bath.—Eleven receipts, taken from a German publication, are given in "Elec.," Aug. 18.

Precipitation of Metals.—The Lond. "Elec. Rev.," August 10, in an editorial, gives the conclusions from a paper by Messrs. Mylius & Fromm from a German chemical paper; among other things it is stated that the black precipitate formed on the zinc of a Daniell cell consists of a copper-zinc alloy.

MISCELLANEOUS.

Flying Machine.—The "Zeit. feur Elek.," July 1, gives a brief illustrated description of the paddle-shaped wheel to be used in the Wellner flying machine mentioned in the Digest, Feb. 24; it consists of 8 large paddles linked to two eccentric centres so that the inclination of the paddles changes in accordance with their positions in different parts of their revolution; it appears that it will be driven by an electric motor; the wheel has just been finished and is being erected in Vienna for making a practical test; the wheel weighs 352 lbs. and is intended to lift 330 lbs. additional; it is thought that the speed of transit will be much greater than that of the fastest locomotive; the experiments are in charge of the Austrian Society of Engineers and appear to be exciting great interest among engineers.

Electrically Driven Balloon.—The "Zeit. feur Elek.," August 1, gives the following data about the balloon at the Antwerp Exhibition, already described in these columns (see Digest Januury 27 and May 26). It is 85.5 meters long, 17.5 meters wide and is cigar-shaped; its volume is 13,373 cubic meters and will carry a total of 9,800 klgr. of which 4,400 is the weight of the balloon and the gondolas, 2,210 that of the machinery and the remaining 31,150 that of the passengers, crew and ballast; the gondola is 50 meters long and 2.5 meters wide, is completely enclosed and is elaborately finished inside; it will carry about 25 passengers; the electric motor develops 125 h. p., and drives a screw propeller 8 meters in diameter; the trolley line consists of wires having a total strength of 75,000 kilograms and runs through the city on poles about 100 ft. high. The balloon will ascend to a height of about 1,000 ft. and travel a distance of 2.1 miles.

Purifying Graphite or Carbon.—A purifying process is described briefly in the "Elek. Tech.," July 31, the graphite is ground to a fine powder mixed with chlorate of potash or chlorate of soda in the proportion of 18 to 1, after which sulphuric acid of 1.8 sp. gr. is poured over the mass in the proportion of 2 lbs. of acid for 11 lbs. of graphite; the mixture is heated moderately until no more vapors arise; the chlorine evolved forms soluble salts of the metals which are contained as impurities in the carbon; to free it from silicates it is treated with sodium flouride.

Improved Carbons.—When heated to very high temperatures the various kinds of carbons pass into the graphitic condition, according to the Lond. "Elec. Rev.," Aug. 10; Messrs. Girard and Street have applied this to the manufacture of graphitic carbon; for electrical purposes the temperature is produced by an electric current or by the arc, in which the ordinary carbon will soften, weld and even fuse and sublime.

Motors vs. Belts.—According to "La Lum. Elec.," Aug. 4, the locomotive works at Dusseldorf have been using electric motors for almost a year in the foundry, resulting in a saving of about $5,000 per year over the former method of using belts and intermediate transmission.

Application of Power in Bridge Building. In the "Elek. Zeit." August 2, Mr. Rohde gives an illustrated description of an interesting application of electric power for operating traveling cranes in the construction of what is to be one of the largest arch bridges; electric power was resorted to to facilitate the work and to enable the steam engine to be placed at some distance from the structure; series motors of 7 h. p. are used, the generator being a compound dynamo; in order to prevent the circuit from being opened completely by the stoppage of the motors, an automatic apparatus is used, which inserts a dead resistance at such times.

Electrification of Explosive Powders. The Lond. "Elec. Rev.," July 27, in an editorial calls attention to the fact that such substances become highly electrified if exposed to friction in the course of manufacture or handling, but if they be glazed with graphite, the particles become conductive and the electrification does not take place, it has been claimed that many of the mysterious explosions may be traced to the ignoring of this electrification; in Government factories it is the rule to exclude or cover all metallic surfaces, but this converts the shed, in effect, into a large Leyden jar; to prevent this all metallic surfaces should be properly earthed.

Fire Damp Detector.—In the Fletcher detector, described briefly in the Lond. "Elec. Rev.," Aug. 10, a platinum wire is contained in a tube of wire gauze and another in a sealed tube containing air; when a current is passed through both they will glow with equal brilliancy in air, but when in an atmosphere of inflammable gas, the spiral in the wire gauze tube will glow more brilliantly, the brilliancy being in proportion to the amount of gas; by means of an ingenious arrangement similar to that of a photometer, the actual percentage of dangerous gas can be calculated.

Locating Underground Watercourses by Means of Electricity.—In an apparently serious notice in the "Zeit. feur Elek.," July 1, an Austrian nobleman, von Sedezicz, is said to have located 3,000 sources of water in all parts of the world with but 12 failures, by means of electric apparatus, somewhat indistinctly described but apparently consisting of platinum chains and balls worn on the body, one end of the platinum chain terminating on the finger, another connection being with a platinum plate on the foot; the other hand holds a magnet and a watch; in walking over a place where there is water in the ground one of the balls "becomes active" and follows the water course, indicating also the depth. The article adds that he also makes a careful study of the topography and geology of the district, which "facilitates" his work.

Physiological Effects of High Frequency Currents.—In reply to a statement made in a paper by Dr. Morton, of New York, Mr. Swinton states, in the Lond. "Elec. Rev.," Aug. 10, that at present no instruments exist that are capable of measuring even approximately, the correct amperage or voltage of Leyden jar discharges, and that therefore any conclusions based on them are misleading.

Electrocution.—A paper by Mr. de Fonvielle, read before a French society, is published in full in "La Lum. Elec.," July 28; in it he discusses electrocution, arguing in favor of it and recommending its adoption in France.

A Synchronic Photograph.—Under this heading the Lond "Elec. Rev.," Aug 17, publishes a curious photograph of a large Ferranti fly-wheel alternator; the light was supplied by the alternating arc lights run from the dynamo itself; the exposure was for 10 minutes, during which time the fly-wheel made nearly 1,000 revolutions; from the photograph it seems as though the revolving field magnet and fly-wheel are stationary, being held in space, as no arm, or other means of support are visible; so perfect is the original photograph that one can count the windings on each of the many field magnet coils.

Electric Porcelain Muffles.—The Lond. "Elec. Rev.," Aug. 17, suggests that muffles for the firing of delicate porcelain wares might be used with success when electrically heated, as that would completely avoid the evil effects of the products of combustion of the fuel on the delicate glazes and colors.

Artificial Rubies.—The "Elek. Anz.," July 22, states that in France artificial rubies are made in large quantities intended specially for bearings in watches; they are made electrically by fusing clay with barium fluoride to which chromium salts are added to give the red color.

Copper Production.—The "Zeit. feur Elek.," Aug 15, reprints a paper compiled by a London firm, giving the copper production of different countries for the past four years; that produced in the United States was nearly half of the total production of the world.

Acid Proof Paint.—The "Elek. Anz.," Aug. 9, gives a receipt of Mr. Carrè; pure, finely pulverized asbestos is mixed with a small amount of syrupy solution of water glass, the plastic mixture obtained being thinned with a solution of water glass containing as little free alkali as possible.

Tinning.—According to the "Elek. Anz.," July 22, articles to be tinned are first electro-plated with an alloy of iron and nickel or cobalt, after which they are tinned as usual; the bath consists of nickel or cobalt sulphate, nitrate or chloride, sulphate of iron and citric acid.

Electricity on Ships.— A long serial by Mr. Gelcich has been running through a number of issues of the "Elek. Echo," on "The Application of Electricity on Ships During the Past Twenty Years;" the serial is concluded in the issue of Aug. 18.

Purification of Water.—An article by Mr. Oppermann on the electrical purification of water is published in the "Elek. Echo," Aug. 18.

Life Buoy.—An illustration of the one described in the Digest, Aug. 25, is published in "L'Elec.," Aug. 11.

Patent System.—The leading editorial in the Lond. "Elec. Rev.," Aug. 10, discusses the question of the examination of applications for patents, arguing in favor of the British system in which no examination is made, a patent being granted to the first applicant; it is claimed that the examiners are not always competent and that the interference proceedings are "a disreputable game;" the Edison lamp patent is cited as an example; it is claimed that there is no harm in granting a worthless patent, while to refuse a patent due to the examination of an incompetent examiner is manifestly unjust.

Lightning.—"La Lum. Elec.," July 28, abstracts briefly from a recent work by Mr. de Fonvielle, on aeronautics, in which a statement is made that it is a mistake to believe that balloons cannot be struck by lightning, as recent observations have proved that flying birds are susceptible to being struck by lightning during a storm.

Steam Engines.—"La Lum. Elec.," Aug. 4, extracts briefly from a work by Prony published in Paris in 1826 on "The New and Old Steam

Engines at Paris, etc.;" the book contains a description of the well-known Prony brake.

Keely Motor.—In an article of some length in the Lond. "Elec. Rev.," Aug. 10, the Keely motor and the writings of Mrs. Bloomfield Moore are discussed.

Electrical Quilt.—According to the Lond. "Elec. Rev.," July 27, an exhibit at the Royal Society consisted of a quilt or cushion containing a resistance wire, in which warmth may be produced by an electric current; it is suggested to use this in hospitals, especially in cases of surgical operations. The Lond. "Elec. Eng.," July 27, contains a somewhat more complete description.

British Association Meeting at Oxford.—In the Lond. "Elec.," Aug. 7, is published a list of the electrical papers read at the meeting accompanied by an account of the meeting for each day; a general discussion of the meeting is published in the Lond. "Elec.," which contains also an editorial on the Mechanical Section. A large number of the papers are contained in the English journals of Aug. 17, specific references to which will be found above under the divisions to which these papers belong. Some criticisms of the terms used are made in the Lond. "Elec.," Aug. 17. The attendance was 2,321, which was several hundred in excess of last year's meeting. Lord Salisbury's and Prof. Rucker's Presidential addresses are published in the Lond. "Elec.," and "Elec. Eng.," Aug. 10. The address of Mr. A. B. W. Kennedy on "The Critical Side of Mechanical Training, and the paper by Sir Frederick Bramwell on "Some Reminiscenses of Steam Locomotion on Common Roads" are published in the Lond. "Elec. Eng.," Aug. 10; the former is published in full in the Lond. "Elec.," Aug. 17, and is discussed editorially in the same issue; the Lond. "Elec.," Rev.," also criticises and discusses the paper.

Prizes.—According to the Lond. "Elec., July 27, handsome prizes are offered in connection with the Paris Exhibition of 1900 for the solution of three elementary problems; the transmission of sight to a distance, chromo-photography on paper and electric lighting without focus by cold light with the aid of electric undulations of great frequency. A list of the prizes offered by a French Sociey, are given in "L'Ind. Elec.," July 25, and "L'Elec.," Aug. 4 and 11, and those of another society in "L'Elec.," July 21.

Biographical.—A biographical sketch of the late Prof. August Kundt is given at some length in the "Elek. Zeit.," July 26, the Lond. "Elec.," Aug. 10, publishes a steel portrait and a biography of the late Heinrich Hertz.

La Lumiere Electrique.— The publication of this French electrical journal has been suspended for the present. The directors hope to be able to resume the publication of it at some future day. The first number was issued April 15, 1879, and the last one received at this office was issued August 4, 1894; according to a statement of the directors it has been published at an annual loss of $14,000.

Moonlight Tables for October, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of October under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	6.10 P. M.	2	5.00 A. M.	1	6.10 P. M.	2	5.00 A. M.
2	6.10 "	3	5.00 "	2	6.10 "	3	5.00 "
3	7.00 "	4	5.00 "	3	6.10 "	4	5.00 "
4	7.50 "	5	5.00 "	4	6.10 "	5	5.00 "
5	8.40 "	6	5.00 "	5	6.00 "	6	5.00 "
6	9.40 "	7	5.00 "	6	6.00 "	7	5.00 "
7	10.40 "	8	5.00 "	7	6.00 "	8	5.00 "
8	11.40 "	9	5.00 "	8	6.00 "	9	5.00 "
9	—	—	—	9	6.00 "	9	12.00 M.
10	12.40 A. M.	10	5.10 A. M.	10	12.40 A. M.	10	5.10 A. M.
11	1.50 "	11	5.10 "	10	6.00 P. M.	10	12.00 M.
12	2.50 "	12	5.10 "	10	6.00 "	11	"
13	3.50 "	13	5.10 "	11	5.50 "	12	"
14	No light.	14	No light.	12	5.50 "	13	"
15	"	15	"	13	5.50 "	14	"
16	5.50 P. M.	16	7.10 P. M.	14	5.50 "	15	"
17	5.50 "	17	7.50 "	15	5.50 "	16	"
18	5.50 "	18	8.40 "	16	5.50 "	17	"
19	5.40 "	19	9.40 "	17	5.50 "	18	"
20	5.40 "	20	10.50 "	18	5.40 "	19	"
21	5.40 "	22	12.00 A. M.	19	5.40 "	20	"
22	5.40 "	23	1.20 "	20	5.40 "	21	"
23	5.40 "	24	2.30 "	21	5.40 "	23	1.20 A. M.
24	5.40 "	25	3.50 "	23	5.40 "	24	2.30 "
25	5.40 "	26	4 50 "	24	5.40 "	25	3.50 "
26	5.30 "	27	5.30 "	25	5.40 "	26	4.50 "
27	5.30 "	28	5.30 "	26	5.30 "	27	5.30 "
28	5.30 "	29	5.30 "	27	5.30 "	28	5.30 "
29	5.30 "	30	5.30 "	28	5.30 "	29	5.30 "
30	5.30 "	31	5.30 "	29	5.30 "	30	5.30 "
31	5.30 "	1	5.30 "	30	5.30 "	31	5.30 "
				31	5.30 "	1	5.30 "
Total No. of hours, 211.30.							

NOTE.—These schedules are made up on sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

New Book.

DICTIONARY OF ELECTRICAL WORDS, TERMS AND PHRASES. By Edwin J. Houston, Ph. D. (Princeton) Third edition, greatly enlarged. New York: The W. J. Johnston Company, Ltd. 1894. 669 double column octavo pages, 582 illustrations. Price, $5.00.

A dictionary of this kind, while invaluable to the electro-technical expert as containing in a condensed space a very large amount of important information, appeals directly to the requirements of the reading public. Only a few years ago it was possible for even the well educated to practically ignore the nomenclature and terminology that at that time were rapidly developing among electrical experts, under the beneficent anspices of electrical science and art. To-day, however, this condition of affairs is changed, and so deeply has electricity entered into our every-day lives, so closely has it become associated with domestic requirements, and so inseparately has it become connected with every branch of useful and scientific knowledge, that it is absolutely impossible for any general reader, who aspires to the most mediocre standard of a liberal education, to ignore the terms, phrases and expressions in which electricity is universally expressed.

The fact that electrical science and engineering employ a common and universal language of units and measurement all over the civilized world, has had a great share in the rapid developement of an international code of language and an international development of ideas upon this subect. In this respect electricians are far more favored than any other branch of technical workers, for the terms and phrases which enter into the technology of any other subject are necessarily more or less local to the language and country where they are found indigenous, so to speak, to its soil. On the contrary, terms, phraseology and language which elecricians employ are far more nearly international, and the favor which this book has met with outside the United States, and even in countries where the English language is not the vernacular, is an evidence of this very fortunate condition of affairs.

It becomes absolutely necessary, therefore, that all who endeavor to keep pace with the rapid march of scientific and industrial progress should either so far familiarize themselves with the electrical nomenclature of the day as to permit them to follow without effort electrical applications and their descriptions; or, at least, to have at hand a book of this authoritive character, by which the explanation of any of the frequently recurring terms and phrases dealt with in electrical literature can be explained.

The very rapid growth of electrical industrial applications, as already referred to, has been fraught with one danger, namely, that the continual necessity for the introduction of new terms by which to express the perpetual growth of ideas should be carried out confessedly by those who care little for the proprieties of language or the precedents of forms of speech.

A perusal of this dictionary proves that we are largely indebted to its author for the efforts he has made to collate and compare various conflicting terms that have come into employment, showing the merits of some and advocating the dismissal of the more ill-chosen terms. The book, therefore, becomes immediately a standard of reference to those who are familiar with the various expressions employed, and the well-known philological attainments of the author have rendered him peculiarly fitted to execute the task he has undertaken.

The style in which the definitions and descriptions are given is not only popular, but complete, the language being such that while a clear and full description is offered upon all terms, even the most unfamiliar reader can readily comprehend them. A great difficulty in the preparation of a dictionary of this kind is either to err on the side of diffusiveness or of conciseness, and the treatment here presented appears to have followed a very happy medium.

One of the most important points in the plan is a system of cross-reference, which is fully developed. It is true that such a system of cross-references is not urgently needed by those who are familiar with electrical terms and phrases, who only seek exact definitions, but on the other hand to the uninitiated and general reader, who may be unfamiliar with the relative prominence of the various terms constituting a phrase, the cross references are of undoubted value.

The book is by far the most complete encyclopedia of electrical phrases that has ever made its appearance in any language. It will be found valuable alike to the scientist, the engineer, the therapeutist, the lineman, telegrapher, artizan, and general public. The third edition has received an appendix containing about 20 per cent. of the previous contents, and the book has been greatly enlarged. It is well printed in excellent type.

NOTE.

The contents of the Physical Review for July-August, 1894, the first number of a new volume, are up to the high standard which has characterized this periodical from the beginning, and, as usual, electricity takes up a goodly proportion of the space. The leading article is by Messrs. Clayton H. Sharp and W. R. Turnbull on "A Bolometric Study of Light Standards." The results of the experiments demonstrate the futility of any attempt to get concordant photometric results from freely burning candles unless with a very long series of observations; they also show the superiority of the English over the German candle, and that with the Hefner standard a very good average may be expected from a series of observations extending over a comparatively short time. Dr

Charles B. Thwing in a paper describes some experiments which establish to a considerable degree of probability that there is a definite relation between specific inductive capacity and the chemical constitution of matter. Among the minor contributions are an illustrated description of the physical laboratory of Adelbert College, and accounts of a laboratory experiment in simple harmonic motion by Mr. John O. Reed and of some experiments in electric photography by Mr. Fernando Sanford. Professors Sanford and Carhart have another bout in regard to the claim of the former that he has established the fact that the electrical conductivity of copper is affected by the surrounding medium. (Ithaca, N. Y.)

European Red Tape.

It is stated that the reason why a certain electrically driven carriage from Italy could not take part in the recent competition held in Paris, was that the French custom-house officials could not make up their minds what duty to charge for electrical carriages, and therefore could not admit this one into France.

A Large Electric Transmission Plant.

Contracts have been closed for a large two-phase transmission plant at Montmorency Falls, the current generated to be conveyed to Quebec, eight miles distant, for light and power purposes.

The Falls have a head of over 300 feet, altogether, one portion being a perpendicular fall of 268 feet, and for the past ten years a part of the water power has been utilized for supplying Quebec with current for lighting. The present plant consists of three 2,000 light single phase A. C. machines made by the Royal Electric Company, Montreal, and fifteen arc light machines with a total capacity of 600 lamps; the former generate current with a voltage of 1,800 at the Falls which drops to 1,000 volts at Quebec, and is used for supplying an ordinary lighting service.

Some time ago the Montmorency Electric Power Company decided to put in a modern plant, and, after investigating different systems, has finally ordered three 675 h. p. two-phase alternating generators from the Stanley Manufacturing Company, Pittsfield, Mass. The machines are to generate current at a voltage of 5,500, and the out-put of each will be carried, with a drop of 6 per cent., by four wires to a sub-station in Quebec, where step-down transformers will reduce to 2,000 volts, which will be the voltage of the distributing system. These transformers, which will also be furnished by the Stanley Company and aggregate 1,000 kilowatts in capacity, are to be placed in a sub-station built purposely for their reception and provided with very complete arrangements for keeping them cool by air blasts. The current will be used for lighting, general power distribution by two-phase A. C. motors, and for electric street railway power through the intermediary of rotating transformers. In the sub-station there will also be a very complete switchboard installation, including a switchboard for the railway service, one for the arc light service and one for the two-phase light and power service. The offices of the Company will also be in the same building.

The type of generator to be furnished is similar to that illustrated in the Electrical World of June 16, 1894, the main points of which are stationary armature and a revolving field or inductor containing no wire whatever. Another feature is that the form of curve of E. M. F. generator approximates very nearly to a sine curve, the advantages of which have recently been so strongly referred to in our columns. When the new addition is furnished, the Montmorency plant will be one of the most complete in existence, and much of the credit will be due to Mr. F. H. Badger, the general manager of the Montmorency Electric Power Company. Mr. Badger, who is a son of the City Electrician of Montreal, was with the Royal Electric Company for ten years, and is an electrical engineer of more than ordinary acquirements. He connected himself with the Montmorency Company on February 1, 1894, and much of the recent progressiveness and success of this company has followed from his able management.

Turbine Tests.

We are indebted to the Dayton Globe Iron Works Co., successors to Stout, Mills & Temple, Dayton, Ohio, for the results of some tests recently made at the Holyoke testing flumes, Holyoke, Mass., on a new line of its New American Turbine Water Wheels, in which the capacity has been greatly increased for each diameter. It is scarcely necessary to point out that high efficiency at whole water and low efficiency at part water does not constitute a first-class turbine, as it is impracticable to properly operate any kind of machinery without reserve power. A margin must be left for emergencies and for fluctuation of load, and it is claimed that the construction of the New American turbine is such that the highest efficiency is obtained at 7/8 to 3/4 water, as seen by the following, which is copied from the official reports:

Test of a 45-Inch New American Turbine, July 9, 1894.

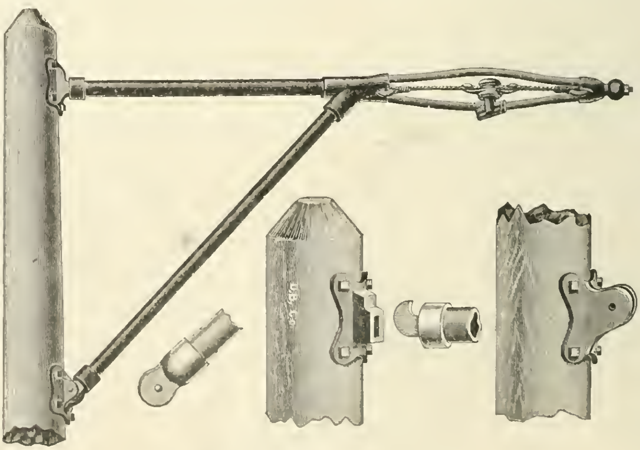
Whole Gate (meaning whole water)	79.76 per cent.
7/8 " "	82.58 "
3/4 " "	82.18 "
5/8 " "	79.31 "
1/2 " "	75.52 "
Average efficiency from whole to half water	79.87 "

Test of a 42-Inch New American Turbine, July 14, 1894.

Whole Gate (meaning whole water)	80.50 per cent.
7/8 " "	83.09 "
3/4 " "	82.77 "
5/8 " "	79.21 "
1/2 " "	70.60 "
Average efficiency from whole to half water	79.25 "

A Flexible Pole Bracket.

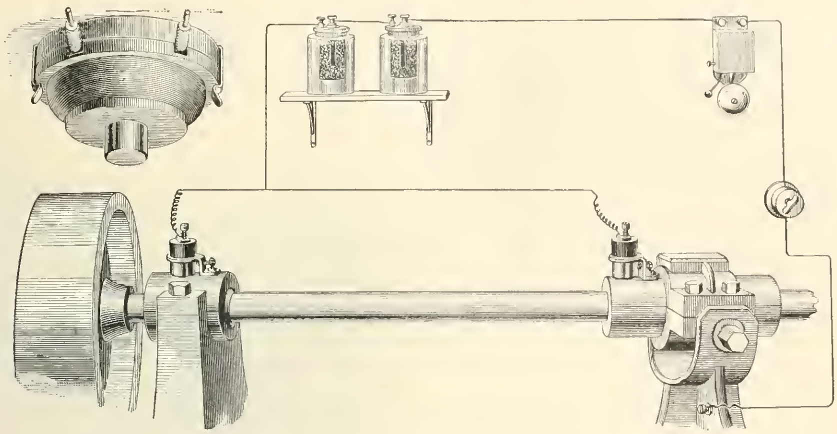
The Woods' flexible pole bracket, manufactured by the Ohio Brass Co., of Mansfield, Ohio, and of which we give an illustration, overcomes the hammering effect of the trolley wheel on the hanger that is due to the rigid construction ordinarily used on the regular pole bracket, and makes a yielding and flexible support, therefore allowing cars to be operated at a high rate of speed without the evil results heretofore experienced. It combines the best features of the cross and bracket suspensions, and the peculiar construction of the upper pole socket and hook allows the bracket to be easily swung into position and admits of adjusting the horizontal arm vertically. The straight line hanger is suspended between the curved arms on the steel strand cable, the taughtness of which can be adjusted by means of the eye bolt at the end of the bracket. The spread of the curved arms is six inches at their greatest width, and the distance between the centers in which the cable is suspended is two feet. The fittings for this bracket are made of malleable castings to insure greater strength.



Flexible Pole Bracket.

Journal Bearing Alarm.

The journal bearing alarm system of the Electric Heat Alarm Company, Boston, Mass., as illustrated herewith represents the simple method of wiring involved. The thermostat, as shown on the main shaft, consists of a steel cup filled with mercury and kept in position by a non-conducting fibre plug. The screw shown in the centre of this plug is connected by wire to cells of an ordinary open circuit battery, vibrating bell and switch, which constitutes one pole of the circuit. The other pole is attached to the supporting shaft. The thermostat is held in position by a small metal holder fastened to the cup of the bearing by an 8-32 machine screw. When the bearing near the pulley becomes overheated, the mercury expands and closes the circuit, thus causing the bell to ring the alarm. The attendant throws the switch to stop the ringing of the bell, and then removes the thermostat by slackening the screw shown in cut, and cools the bearing; by the time the bearing is cooled, the thermostat has come to its normal condition and is ready to be placed in holder for another alarm. Through the journal bearing of this company and a switchboard arrangement, any number of shafts can be connected and the heating of the thermostat on any one of them located.



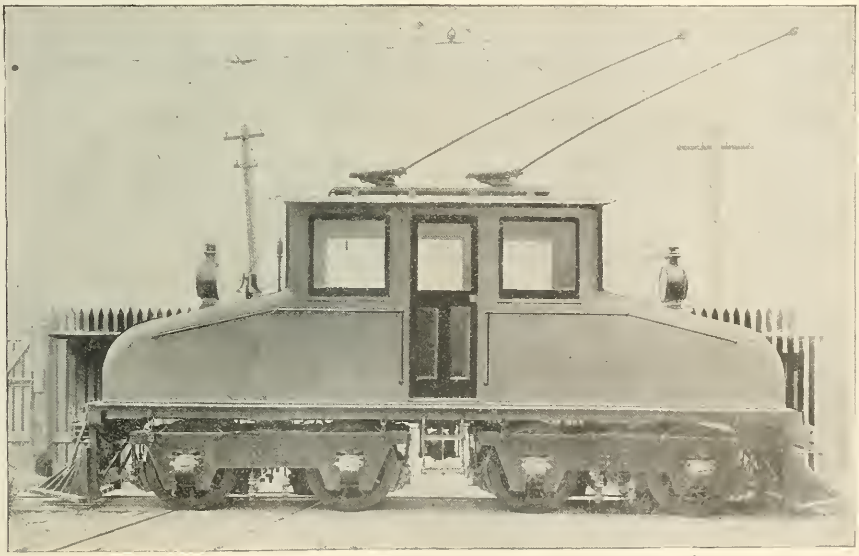
JOURNAL BEARING ALARM.

A Forty-Ton Electric Locomotive.

Our readers will recall an interesting description published among our articles on the electrical exhibits at the Chicago Exposition, of a thirty-ton electric locomotive built by the General Electric Company. From thirty tons and one motor truck to forty tons and two motor trucks is but a step, and the General Electric Company has only recently made it. This forty-ton locomotive is now standing in the factory yard at Lynn, and, as will be seen by the illustration, is an imposing looking electrical engine.

It is designed to perform the ordinary work of a steam locomotive of similar capacity where excessive speeds are not requisite, up to about thirty miles an hour. It has two similar but independent trucks, each having four wheels. Each pair of wheels is driven by its own specially designed motor of the single reduction spur geared type, mounted upon the axle as in ordinary street car practice.

The truck frame is constructed of plate iron and channels, designed to obtain at the same time both strength and simplicity. The entire weight of the frame, including the cab, is carried on elliptical springs resting directly on the top of the journal boxes. This suspension



FORTY-TON ELECTRIC LOCOMOTIVE.

secures easy riding and minimizes the wear both on the locomotive and the truck. The journal boxes are of cast iron with phosphor bronze bearings hydraulically pressed in. Lubrication is provided by means of a large well for oil and waste. The box slides in jaws intended to take up the wear. The journal bearings being outside, all parts are easily accessible for purposes of inspection and repair, and, to ensure against any bending caused by hard usage, the axle and journals are made large.

The cab rests on the truck in a manner somewhat similar to that in which the ordinary passenger car is mounted, an ample margin for wear and strength being provided. The cab itself is constructed of sheet iron and the windows in it are so arranged as to give an almost unobstructed view from one position in all directions. The design of the cab is such as to give plenty of available floor spaces without making the top of the cab long enough to obstruct the sight. The form of the cab also makes a symmetrically shaped locomotive.

The electrical equipment comprises, besides the motors, a series parallel controller, an air compressor, which provides the air for the brakes and whistle, and the automatic safety devices. In addition there are the bells and headlights and sand boxes.

The dimensions of this locomotive are as follows:

Weight	40 tons.
Draw bar pull	14,000 pounds.
Height over all	11 ft. 2 in.
Length over draw bars	24 ft.
Width over all	7 ft. 4 in.
Wheel base of single truck	6 ft.
Diameter of drivers with 3-inch steel tires	40 in.
Number of drivers	8
Size of journals	4½ in. × 8 in.
Gage	4 ft. 8½ in.

Accumulators for Electric Traction and Propulsion.

Those who read the description some months ago in our columns of the operation of three of the street railroads of Paris, France, by chloride accumulators, will be interested to hear that the same battery is now in use operating the street railways of Birmingham, England, replacing the Epstein batteries formerly employed. The Chloride cells operate at least 60 miles on every charge, and could do 80 miles if it were necessary, thus enabling each car to be operated with one set of batteries instead of two as has been the practice heretofore.

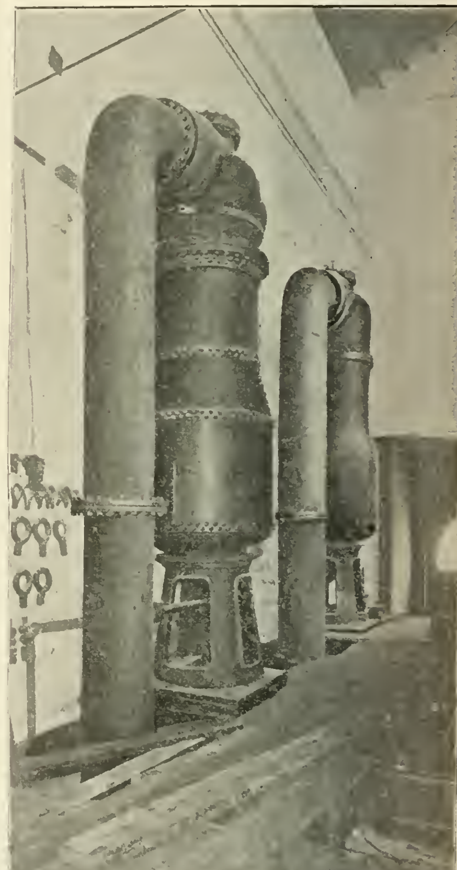
The English company (The Chloride Electrical Storage Syndicate, Limited) has also supplied batteries to Messrs. Mather & Platt for use on the trolley road on the Isle of Man running between Portevada, the Douglas terminus, and the Laxey terminus. At Groudel Glen, situated two and a half miles from Douglas, a battery of 240 cells has been erected in a building specially constructed for the purpose, having a capacity of 140 amperes for three hours, or 70 amperes for nine hours, and are remarkable for the exceedingly level curve of E. M. F. which they maintain up to the end of discharge, and for the very high rate at which they can be discharged without detriment. Half the cells of the battery are of the chloride Company's patent protected type, with teak separators and asbestos diaphragms similar to those now being used on the Birmingham tramways, and the other half unprotected. The cells are charged direct from the line or from a motor generator, which is of special design by Messrs. Mather & Platt, and giving the required additional E. M. F. This is the first instance of accumulators being used as a fixed battery for tramway or railroad work in England, although a similar step has been taken on the Continent in the case of the Zurich-Hirslanden tramway. The battery at Groudel Glen serves not only the function of supplying the extra power required at times of maximum demand, but it is intended during the winter months to work the light cars.

The same English company also recently equipped the electric launch Aphrodite, which has the first equipment of chloride cells used on the Thames. This, launch says an English contemporary, has been specially built in order to demonstrate their superiority for this class of work, their large capacity for a given weight enabling distances and speed to be run without charging, which was previously impossible. The cells with which the Aphrodite is fitted are capable of being discharged at a very high rate, and, on the measured mile, a speed of nine miles per hour has been obtained, and this rate can be continuously maintained for about three hours, which is a record performance for an electric launch of this size; at a slower speed, namely, 6½ miles per hour, which is the usual rate of travel, and which is still considerably above the average speed of electric launches of this size, a day's run of nine hours can be undertaken, inclusive of the time through locks. One feature of the chloride cells referred to by the writer we quote is that although at very high rates of discharge their capacity for a given weight greatly exceeds that of other types, their increased capacity at a low rate is still proportionately greater, and on this account, with the reduced speed of 5½ miles per hour, the battery power with which this launch is provided is capable of covering a distance of approximately 110 miles."

Steam Separators for Power Stations.

The illustration shows two of a total of six Stratton steam separators, all of more than usually large size, recently furnished by the Goubert Manufacturing Company, New York, to the Philadelphia Traction Company for its new power stations at 13th and Mount Vernon streets, and 33d and Market streets, Philadelphia. Two of the separators are 18 inch, two 16 inch and two 8 inch. One of the 18 inch separators is seen in the foreground of the engraving.

The Stratton steam separator is based upon the principle that if a rotative motion is imparted to the steam, all the liquid particles it may contain, being heavier than the steam, acquire centrifugal force and are projected to the outside of the current. It consists of a vertical cylinder with an internal central pipe extending from the top downward, for about half the height of the apparatus, leaving an annular space between the two. A nozzle for the admission of the steam in on one side, the outlet being on the opposite side or on top, as it may be most convenient in making the connections. The lower part of the apparatus is enlarged to form a receiver of considerable capacity, thus providing for a sudden influx of water from the boiler. A suitable opening is tapped



MAMMOTH STEAM SEPARATOR.

at the bottom of the apparatus for a drip connection, and a glass water gauge shows the level of the water in the separator at all times.

The current of steam on entering is deflected by a curve partition and thrown tangentially to the annular space at the side near to top of the apparatus. It is thus whirled around with all the velocity of influx, producing the centrifugal action which throws the particles of water against the outer cylinder. These adhere to the surface, so that the water runs down continuously in a thin sheet around the outer shell into the receptacle below, while the steam, following a spiral course to the bottom of the internal pipe, abruptly enters it, and in a now dry condition passes upward and out of the separator, without having once crossed the stream of separated water, all danger of the steam taking up again such water after separation being entirely avoided.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, September 1, 1894.

THE ELECTRICAL STOCK MARKET, now that uncertainty relative to tariff legislation has been eliminated from the financial and commercial situation, is beginning to reflect as a whole the impetus that has been given by the cessation of the agitation to all branches of trade. So far as the speculative favorites are concerned, most of the week's development in quotations is due to the work of pool operations, but trade conditions agree fully with the opinions voiced in the last issue of The Electrical World, and quotations are beginning to advance in keeping with the renewed progress toward profit making.

GENERAL ELECTRIC'S quotations hardly bear out these remarks, closing as they do, some two points lower than a week ago. But peculiar causes have combined in this instance to depress values. The stock has been rather freely bought of recent weeks by people who have become acquainted with the good business prospects of the company, and, having paper profits of several points, undertook to realize. There has been, just now, no liquidation of stock, as Wall Street understands liquidation, i. e.: selling out of long stock acquired and bought outright for investment purposes. The small pool that carried the price up on the recent rise was not successful in marketing its stock at the high prices, and, having acquired more stock on the rise than it cared to carry, has been obliged to realize on a good part of its holdings, even at a decline of a point or two. The slump of the last few days has been accompanied, as usual, by adverse rumors. The bears on the property speak of an increase in opposition, competition from Western electric plants being stated to be growing at a rate that threatens serious inroads on the General Electric's business in that quarter. But the company's management insists that its business continues to grow apace. It is announced in one bulletin that it made from the Lynn works this week the largest shipment ever made from any electrical factory, twenty-five loaded cars in a single train having been forwarded, consigned to the General Electric Company, of Portland, Ore. This does not look like poor business, and, if any selling of the stock is being done, it is altogether for the account of the aforementioned pool. No matter what is thought of General Electric stock, the general opinion regarding the debenture 5's is clearly demonstrated by the fact that they are now within a couple of points of par. Rumors are current that the company has been retiring some of the bonds, but this is not in all likelihood so. It is pointed out in an interiew published in the Wall Street Journal that the more logical theory would be to retire a portion of the preferred stock outstanding, nearly $4,251,900. General Electric preferred now sells about 72; this price includes 10½ per cent. accumulated dividends, making the value of the stock but 62, a very low figure for a first lien on all the assets of the company after the debenture bonds, the more so in view of the comparatively high price of the common stock. The movements in the stock, it is pointed out, do not indicate transactions of considerable size, but, nevertheless, the quotations recorded may be used as a basis on which to negotiate private transactions of considerable size.

THE FORT WAYNE ELECTRIC people are making a big noise about the way they are cutting into other companies' fields. Gossip in electrical trade circles is to the effect that the Wenstrom works, recently purchased by the Fort Wayne, have been for sale at a song for the past two years, but electrical experts who have examined the plant and apparatus a number of times have generally found that, while the quality of work is good, the generators and motors made by the Baltimore concern are no better than those of a dozen other makers.

THE SIEMENS-HALSKE COMPANY, of Chicago, backed as it is by tremendous capital and located in the West, where the bulk of new electrical enterprises is arising, it is destined to play an important part in the Western field, hitherto General Electric's own. Its quick re-establishment after its recent fire experiences, shows that it is here to stay, and in the ever-increasing demand for electrical industries, the Siemens-Halske Company will be found to be a competitor that is a powerful factor in the acquisition of electrical contracts.

WESTINGHOUSE ELECTRIC preferred and common stock issues hold their own. Trading in these stocks just now is very limited, but that values do not sag is a good indication of the esteem in which they are held by the trading fraternity. Once the company begins showing what can be accomplished in the way of cheap and efficient product in the new works, renewed interest will be taken in its issues, and values must appreciate. It is announced that interest due to-day on the company's scrip will be paid. Transfer books remain closed till September 4.

THE AMERICAN BELL TELEPHONE COMPANY'S statement as to instrument output furnishes good evidence as to general business conditions. The statement for the month ended August 20, shows a small gross output of telephones, yet 1,528 more than were put out a year ago, when times were at the worst. The returns were larger than the shipments by 842, which compares with net returns of last year of 2,435. Since December 20, 1893, the gross output has been 53,144, the net being 6,164 after deducting instruments returned, a decrease of 18,115, as compared with a year ago. There were in use on August 20 last, 572,655 telephones, a gain over 1893 of 5,656 instruments. This shows that things are picking up again. Stock movements this week have been unimportant; quotations, however, are good.

BROOKLYN EDISON ELECTRIC ILLUMINATING stock is ruling a little higher on small sales. It was bid at 103 during the week on reports of big business. A week ago the station load was within 10 per cent. of what it was last December around Christmas, showing thus how well the company is doing even in the dull summer months. The new system recently adopted by the company to turn arc lights in Brooklyn on and off by means of individual clock work located on each pole, is working very successfully, and is effecting a great saving, as the lights are properly attended to.

WESTERN UNION TELEGRAPH betrays very little life. There has been some selling for bull account and quotations are fractionally lower, but little significance is attached to current movements in the stock.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	98½	100
" " " Brooklyn	100	101	102
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¾	3
General Electric	100	40	40½
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	33	34
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	1,000	110	111
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	200	201
American District Telegraph	100	40	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	145
Erie Telephone	—	45¾	46
Gold & Stock Telegraph	100	100	103
Mexican Telegraph	100	185	200
New England Telephone	—	68	69
Western Union Telegraph	100	88¾	89

NEW INCORPORATIONS.

THE PANA TELEPHONE COMPANY, Pana, Ill., has been incorporated with a capital stock of $5,000.

THE ACME ELECTRIC COMPANY, St. Louis, Mo., capital stock $3,000, has been incorporated to manufacture electrical supplies and apparatus.

THE JACKSONVILLE ELECTRIC LIGHT AND POWER COMPANY, Jacksonville, Ill., capital stock $100,000, has been formed by G. D. Staffert S. H. Trude and W. H. Lee.

THE LENOX ELECTRIC COMPANY, Lenox, Mass., capital stock $20,000, has been formed to furnish electric light, heat and power. W. D. Curtis, I. I. Newton and W. D. Bull are the promoters.

THE DETROIT LIGHT AND LAND COMPANY, Detroit, Mich., capital stock $100,000, has been formed to supply light, heat and power. E. G. Holmes, E. D. Holmes, and J. H. Smith, all of Detroit, are interested.

THE HARTFORD ELECTRIC STREET RAILWAY COMPANY, Hartford City, Ind., capital stock $100,000, has been formed to operate a street railway. G. E. Reynolds, A. Reynolds and A. Walker are interested parties.

THE CHICAGO, OAK PARK AND HARLEM STREET RAILWAY COMPANY, Chicago, Ill., capital stock $50,000, has been formed; the incorporators are J. C. Schumacher, J. Guaedinger, G. A. Pudewa, F. Proost and H. D. Schumacher.

THE FARMERS' TELEPHONE COMPANY, Massillon, O., capital stock $10,000, has filled articles of incorporation. The promoters are M. S. Card, N. F. Moffet, J. H. Fisher, Wm. Maxhiemer, A. J. Gordon, F. Segoff R. A. Perin and A. Short.

THE MORSE ELECTRIC ECONOMY COMPANY, New York, maximum capital stock $5,000,000, has been incorporated to manufacture and sell storage batteries, etc. The promoters are L. Morse, W. F. Herbert and N. L. Phipp, all of Brooklyn.

THE ALTHAM INTERNATIONAL MOTOR COMPANY Portland, Me., capital stock $5,000,000, has been formed to generate, apply and in any other manner use motive power of all kinds. President, Geo. J. Altham, Lawrence; treasurer, Wm. W. Coe, of Somerville, Mass.

THE ELECTRO-MAGNETIC TRACTION COMPANY, Washington, D. C., maximum capital stock $5,000,000, has been formed to build electric motors, gears, street cars, etc. W. M. Stewart, Carson City Nev., P. B. Thompson, Jr., New York, and R. E. Shear, Denver, Col., are interested.

THE ATCHISON RAILWAY, ELECTRIC LIGHT AND POWER COMPANY, Atchison, Kan., capital stock $300,000, has been incorporated by H. O. Odell, G. W. Riggs and A. E. Cullingworth, of Chicago; W. P. Waggenner, E. Engels, C. C. Hetherington and S. E. Harburger, of Atchison, to build an electric street railway and to do a general electrical business.

THE LOCKPORT CITY AND OLCOTT ELECTRIC RAILROAD COMPANY, Albany, N. Y., capital stock $200,000, has been formed to construct a surface electric railway about twenty miles in length. W. T. Holt, M. E. Stone, A. G. Funck, J. I. Toch, E. J. Cunningham, T. J. Agnew, N. Gale, G. E. Dunscombe and F. E. Crasson, of New York City, are the incorporators.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Sept. 1, 1894.

MR. H. C. WHITNEY has resigned his position with the Interior Conduit and Insulation Co., 44 Broad street, with which he has been connected as motor salesman for the past six months.

H. B. COHO & COMPANY, 203 Broadway, have changed their offices from room 505, Mail & Express Building, to room 511, same building. The new offices are larger and give much better facilities.

LEWIS K. DAVIS, consulting and contracting engineer, will move from his

present office at No. 1 Broadway, to the Manhattan Life Building, where he will have commodious quarters and better facilities.

MR. ALBERY A. CARY, of the Abendroth & Root Manufacturing Company, has been seriously ill for the past few weeks with appendicitis, and was obliged to undergo an operation. He is at present doing nicely, and expects to be out again in a few days.

THE COMMERCIAL CABLE COMPANY'S steamer, the "Mackay-Bennett," on Saturday laid the last four miles of the in-shore line of the new commercial cable, and on Sunday morning landed the end at the shore terminus, pier A, North River.

A CORRECTION—In the last issue of The Electrical World, in the heading to an article on the entrance of the Western Electric Company into the railway field, an unfortunate typographical error transformed the name of the company into the "Western Electric Railway Company." The name of the company is so familiar in the electrical field that we are sure no one could have been misled.

New England Notes.

Branch Office of The Electrical World, Room 91, Hathaway Building, 620 Atlantic Ave., Boston, September 1, 1894.

MR. R. T. M'DONALD, president of the Fort Wayne Electric Corporation, was in the city this week. Notwithstanding the fact that he and N. E. manager, E. I. Garfield, were very busy together, Mr. McDonald found time to greet briefly but kindly many friends and business acquaintances who happened to know of his presence in the city.

MR. C. E. ROBERTS, of the Brown Electric Company, Boston, Mass., and Miss Fannie F. Bird, both residents of Hyde Park, Mass., were united in marriage in that city August 29. Mr. Roberts is one of the electrical "old timers," and his many friends wish for him and his wife all possible happiness and good fortune.

BOSTON, MASS.—Sealed proposals for furnishing the motor generators, switchboards and other appliances required to equip the battery room of the new fire-alarm headquarters on Bristol street will be received at the office of the fire commissioners until 12 o'clock noon, September 8. Plans and specifications can be seen at the office the of Board of Fire Commissioners, Bristol street, Boston. Robert G. Fitch is chairman.

THE BROWN ELECTRIC COMPANY, Boston, reports business as exceedingly good, and well it may, as there is hardly to be found anywhere an abler staff of workers and "hustlers" than it possesses. President Maybin W. Brown is most of the time on the road scooping business and so is his brother "Bert" (who, by the way, has developed into a capital salesman), and Treasurer Philip W. Reynolds, A. H. Holwand, C. H. Pope and C. E. Roberts know just how to look after office details and customers.

Western Notes.

Branch Office of The Electrical World, 936 Monadnock Building, Chicago, September 1, 1894.

MR. GEO. A. McKINLOCK, president of the Central Electric Company, has returned to Chicago after a few days' recreation.

W. H. M'KINLOCK has returned to his desk after a successful business trip, and reports everything as decidedly on the mend. Business with him is booming just now.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY has closed two contracts during the week for telephone exchanges, one at Columbia, Mo., and another at Palestine, Tex.

P. EDW. SULLIVAN has returned from the Mid-Winter Exposition, where he was electrical inspector of the department, and taken a position with the Jenney Electric Motor Company, at Chicago.

THE CENTRAL ELECTRIC COMPANY intends to push the introduction of Lundell power motors, having made that a separate department, and has sold several important plants within a short period.

THE GILLILAND TELEPHONE COMPANY has succeeded in introducing its telephones in some of the fashionable residences at Lake Geneva. It reports business as very good, and the prospects as bright.

THE METROPOLITAN ELECTRIC COMPANY reports business unusually brisk. Mr. W. H. McKinlock himself is on a short trip, and has, as usual, met with many large orders for the specialties handled by this house.

GEORGE CUTTER sends one of his always welcome reminders on "A Weatherproof Trio," in which he emphasizes some of the good points of "T. Z. R." insulation. Mr. Cutter, as usual, is hustling hard for business.

THE JENNY ELECTRIC MOTOR COMPANY, whose western office was so long presided over by Mr. A. H. Goode, now with the Central Electric Company, was visited last week by President Waples who found quite a number of important matters in connection with prospective sales to attend to. Secretary Jenney was also a Chicago visitor during the week.

THE ALLEN SOLDERING STICK seems to maintain no bounds, judging from the sales the Electric Appliance Company is making in all parts of the country. The demand for this specialty in the East is very large and the Electric Appliance Company is shipping sticks in considerable quantities to Boston, New York, Philadelphia and other Eastern points. The Arnold telephone also seems to be satisfying the demand for a first-class magnetic telephone, and many Eastern, as well as large Western, orders have been booked.

News of the Week.

Telegraph and Telephone.

DUBLIN, TEX.—Dr. J. G. O'Brien proposes to put in a telephone exchange, and is in the market for the necessary instruments and apparatus.

PALESTINE, TEX.—L. C. Ketchum has been granted a twenty-five years' franchise for the construction and operation of a telephone system, and he is now in the market for a complete plant.

WASHINGTON, D. C.—Sealed proposals will be received at the Department of the Interior until 3 p. m., September 24, for the construction of a telephone exchange system for the Department. Proposals will also be received for the extension and modification of the present telephone system of the Interior Department. Bids must be addressed to the Chief Clerk, Interior Department.

Electric Light and Power.

CAMBRIDGE, O.—The Council has voted to issue bonds for the establishment of an electric plant.

PAWNEE CITY, NEB.—The city has voted to issue $4,000 in bonds to enlarge the electric light plant.

LAINGSBURG, MICH.—Laingsburg is considering the question of putting in an electric light plant.

HEMPSTEAD, N.Y.—Proposals are wanted until September 17 for lighting the streets of this place with electricity.

GIBSON CITY, ILL.—S. J. Le Fevre will build a brick electric power-house, and add to his present electrical equipment.

JANESVILLE, WIS.—F. M. Marzluff & Co. will erect a three-story 120x44 shoe factory, and an electric light plant will be put in.

INDEPENDENCE, ORE.—A water and electric light company has been formed. Power enough will be generated to light Monmouth also.

RICHMOND, IND.—The Commercial Club has accepted the plans of Oscar Cobb, of Chicago, for a new hotel. An electric light plant will be put in the building.

UNION CITY, MICH.—Union City's common council will call a special election to vote on the question of bonding the village to purchase an electric lighting plant.

ESTHERVILLE IA.—Address N. B. Egbert, City Clerk, in regard to the construction of an electric light plant consisting of thirty arc and 1,000 sixteen c. p. incandescent lights.

LANARK, HILL.—J. T. Valentine is seeking for an electric light franchise.

WEST UNION, IOWA.—Thomas Von Rolf is seeking a franchise to put in an $8,000 electric plant.

JACKSONVILLE, FLA.—Address D. U. Fletcher, Mayor, in regard to the contruction of electric light plant for which the City Council has voted that $75,000 may be expended.

WHITE PLAINS, N. Y.—The sum of $12,000 will be partly spent by the White Plains Gas and Electric Company in putting in a large dynamo, to be ready for use before winter.

STILLWATER, MINN.—The city clerk has been instructed to advertise for bids for lighting the city, equal to the present system of lighting. The present contract expires September 20.

HENRY, ILL.—The plant of the Henry Electric Light Company, with all machinery, was destroyed by fire. Storrett & Sons were the owners. The estimated loss is $10,000 to $15,000.

LEBANON, PA.—R. H. Hammond states that the matter of erecting a city electric light plant had been submitted to the people, and they decided to erect one, but the Council has failed to act.

NEW BRITAIN, CONN.—Chief Johnson recently made an application to the city for a system of electric lights for the city building, and the committee on supplies has decided to put them in at once.

VICKSBURG, MISS.—The City Council will receive bids until October 1, for lighting the city for three or five years with 75 to 100 arc lights. The field for electric lighting is large and would justify an extensive plant.

VAILSBURG, N. J.—The Committee on Lamps presented a contract from the Newark Electic Light and Power Company for lighting the borough with arc lights. The mayor and clerk were authorized to execute the contract.

GALLATIN, TENN.—The indications are that Gallatin will in the near future have an electric light plant. The mayor and aldermen granted a franchise at its last meeting and work will in all probability be commenced at once.

TAYLORSVILLE, KY.—The Taylorsville Milling & Mercantile Company has been organized to erect a dam and establish an electric plant. The capital is $25,000, and those interested are G. S. Wells, Van R. Foroman and O. P. Tichenor.

FT. HOWARD, WIS. The Ft. Howard council granted David McCartney a franchise to establish an electric light plant. This insures Mr. McCartney's acceptance of the electric street railway franchise and the establishment of both enterprises.

ALLEGHENY, PA. Sealed proposals will be received at the office of the city comptroller until 2 p. m., Sept. 4, for the construction and erection of boilers, engines, dynamos and electrical appliances for the extension of the electric lighting system.

NEW WHATCOM, WASH.—The City Council has rejected the bid of the Bellingham Bay Improvement Company for electric lighting and has decided to readvertise for 40 lights for a period of two years. The present number is 100 of 2,000 c. p. and the price, $9 each per month.

ERIE, PA.—At a meeting of the common council there was some discussion on the ordinance providing for the increase of the city debt in order to provide for a municipal electric lighting plant. The question will be voted on at the coming November election.

WASHINGTON, D. C.—Superintendent Bernard R. Green, who is also engineer of the construction of the new congressional library, is inviting proposals until September 10, 1894, for furnishing three 125-volt direct coupled dynamos and engines for the library of Congress.

BENTON HARBOR, MICH.—This city is making arrangements to put in an electric plant to light the city and business places for, it is claimed, about one-half now charged by the St. Joseph & Denton Harbor Electric Light Company. It is to be run in connection with the city's water works plant.

JACKSON, TENN.—Sealed propoals will be received until October 2 for furnishing, operating and maintaining forty double-arc 2,000-candle power electric

lamps, with the privilege of fifty at the same price per light, for a term of five years. For specifications, etc., apply to Samuel C. Lancaster, City Engineer.

SUMMIT, N. J.—Jonathan Bonnell, George V. Muchmore, F. E. Dana, and others have petitioned the city to grant the privilege to set poles and string wires over the streets, avenues and highways of the township of Summit, for the purpose of transmitting and distributing current for light and motive power.

CHELSEA, MICH.—The Chelsea Electric Light Company is organized with a paid-up capital of $25,000, to furnish either arc or incandescent lights. Charles H. Davis is president, Archie W. Wilkinnin, vice-president, Frank P. Glazner, treasurer, Fred Wedemeyer, secretary, and A. R. Welch, general manager.

BLACKSTONE, MASS.—At a town meeting a committee was appointed to investigate the subject of electric lighting, with a view to ascertaining the least possible cost for which lights for the streets can be obtained when the present contract with the Woonsocket Electric Lighting & Power Company expires.

GRAND ISLAND, NEB.—The City Council has granted a five years' franchise to the Grand Island Light and Power Company for an incandescent light plant. The company has already filed its acceptance and the promoters started east at once to secure machinery. One thousand lights have already been contracted for.

LINCOLN, MASS.—At regular meeting of the Town Council a petition was presented from the Woonsocket Electric Machine and Power Company, of Woonsocket, R. I., asking for the privilege of running wires for the purpose of distributing electricity for light, power and heat in the village of Manville. The petition was granted.

WASHINGTON, D. C.—Sealed proposals for furnishing and delivering three 125-volt direct coupled dynamos and engines for the Library of Congress building will be received until 2 p. m., September 10. Specifications and further information and blank forms may be obtained on application to Bernard R. Green, superintendent and engineer.

ALTON, ILL.—The Alton Gas & Electric Light Company will enlarge its plant materially. A brick addition will be fitted up with a 125 h. p. boiler, a 200 h. p. Corliss engine and an iron-clad alternator. The capacity of the plant will be increased from 1,500 incandescent lamps to 3,000. The lines over the city will undergo a thorough reconstruction.

JAMESTOWN, N. Y.—The Common Council met for the purpose of discussing and voting on the resolutions pertainig to the proposed extension of the municipal electric light plant. The conclusion arrived at was that the Board of Public Works must prepare new specifications for the improvements to be made and re-advertise for bids for doing the work.

MT. HOLLY, N. J.—The new organization which has leased the Mt. Holly Gas Works, has filed articles of incorporation. It will be known as the New Jersey Gas Improvement Company, capital $100,000. George W. Wright, George W. Schriner, Fred C. Viney are interested. The company will operate gas, electric light and power plants. The main office will be located here.

LANCASTER, O.—Bids will be received by the Board of Trustees of the Boys' Industrial School, at its office near Lancaster, until September 14, for an electric light plant, complete in all details, to be erected in accordance with the plans and specifications adopted by the board and approved by the Governor, copies of which will be furnished upon application. C. D. Hilles is secretary.

O'FALLON, ILL.—A franchise has been granted to the Electric Light, Power, Heat and Waterworks Company for twenty years. The company is composed of the following parties: S. C. Smiley, E. Tiedmann, Phillip Heyde, and Joseph Porter, all of O'Fallon. They are going to put up a first-class plant in every respect. The capacity of the plant will be 30 2,000-candle-power arc lights and 3,000 16-candle power incandescent lamps.

BROOKLYN, N. Y.—Sealed proposals will be received at the office of the Superintendent of Charities and Correction of Kings county, Brooklyn, N. Y., until 12 m., September 5, for materials for an electric light plant. Each proposal must be accompanied by a certified check, payable to the order of Charles J. Henry, treasurer, or to the amount of 10 per cent. of the aggregate of the bid. A. Simis, Jr., is president and Bernard Lamb, secretary.

WACO, TEX.—Sealed proposals are solicited for furnishing Waco with electric arc lights, incandescent lights and gas lights for public street lighting, for periods of three, five and ten years, of such candle power as required by the specifications adopted by the city. The successful bidder will be required to furnish the site, plant and all appurtenances complete. The city of Waco will furnish nothing but right of way on public streets and grant franchise. C. C. McCullough is mayor.

CHARLESTOWN, MASS.—The Charlestown Navy Yard is to be equipped with an extensive electric lighting plant. An appropriation of between $15,000 and $16,000 for this purpose is now available, and the work of establishing the plant will be commenced at once. The power station will be located in the great machine shop, while lamps will be distributed about the yard, in the workshops, officers' quarters, and the marine barracks. In addition to this, wires will be run to the receiving ship Wabash.

JACKSONVILLE, FLA., expects to have the road to Pablo beach electrically equipped. The City Council have passed the ordinance to build an electric lighting plant for the city lighting, and it needs only the Mayor's signature to become effective. By agreement the ordinance forbids the city engaging in the sale of lights for commercial purposes, which protects the local gas and electric light company. The new union depot is to be electrically lighted throughout. A special plant will be built and equipped to furnish over 100 arc lights and

WINNIPEG.—It was announced some days ago that a local company was being formed for utilization of the water-power at Rat Portage, in the generation of electric power to be used in the city. All the preliminaries have been completed, and the company is now preparing for operation. This new company will have electric power at Rat Portage of over 50,000 horse-power, and will lay down in Winnipeg power aggregating 5,000 horse-power, which can be increased should the demand require it.

MT. HOLLY, N. J.—The new organization which has leased the Mt. Holly gas works, has filed articles of incorporation. It will be known as the New Jersey Gas Improvement Company, capital stock $100,000, of which the incorporators are George W. Wright, George W. Schriner, Frederick C. Viney and Samuel R. Gaskill. It will not confine its business to Mt. Holly, but will operate gas, electic light and power plants wherever they can be made profitable investments. The main office will be located at Mt. Holly.

AVON, N. Y.—The fact that the streets of Avon are soon to be lighted with electricity is now assured, and operations are to begin towards that end. A company has been formed which will be known as the Avon Electric Company, and is composed of Charles J. Rosendorf and A. E. Young, both of Le Roy, to whom the privilege of placing the poles and stringing the wires throughout the town for that purpose was granted. The firm has already an option, on two building lots, upon one of which a building not less than 30x40 will be erected.

The Electric Railway.

NIAGARA FALLS, N. Y.—The Niagara Falls & Buffalo Electric Railway will build a line from Niagara Falls to Buffalo.

HINGHAM, MASS—The charter for the Hanover Street Railway Company was granted the Railroad Commissioners recently.

COLUMBIA, PA.—Another electric railway between Columbia and Lancaster, via Cardelia, Silver Spring and Rohrerstown is projected.

KNOXVILLE, TENN.—Clark Rude and associates have secured a franchise to extend their electric railway on West Main. and other streets.

BALTIMORE, MD.—The Traction Company's new electric line out Edmondson avenue through Calverton to Walbrook has been completed.

MONTREAL, CAN.—The electric motors which the Royal Electric Company has placed on the Curran draw-bridge can turn the bridge in one minute.

PORTLAND, N. Y.—Contractor Jacobs is putting down the electric road in the east end of the village. Poles will soon be erected and trolley wires strung.

LITTLE ROCK, ARK.—H. F. Auton and Messrs. Fuller and Moss have applied to the City Council for a franchise to build four miles of electric railway.

BRIDGEPORT, CONN.—A petition is before the Common Council from the Traction Company, asking for the right to extend its tracks along Barnum avenue.

NARAGANSETT PIER, R. I.—Citizens are agitating the question of an electic road along the shore from the South Ferry, through Narragansett Pier, to Watch Hill.

COATESVILLE, PA.—William B. Given, B. J. McGrann and Senator Patterson are viewing the route as surveyed for the Pennsylvania Traction Company, from Coatesville and Philadelphia.

PHILADELPHIA, PA.—The West Chester and Philadelphia Turnpike Company has secured a charter for an electric road and trolley from Philadelphia to West Chester, with a branch line to Paoli.

NIAGARA FALLS, N. Y.—Mr. Fred Dean has commenced erecting side poles for the trolley railroad to the Devil's Hole, and it is expected that the excavation on the road will soon be under way.

SAYLESVILLE, R. I.—The town council will meet to consider the petition of the Moshassuck Valley Railway Company (Messrs. W. F. & F. C. Sayles) for the right to build and operate an electric railway in Lincoln.

BROCKTON, N. Y.—O. P. Howell, the projector of Brockton's proposed electric street railway, says that as soon as residents give him the right of way he will put up a forfeit of $10,000 that the road may be built at once.

AMBLER, PA.—The Borough Council of Ambler has passed on ordinance granting the franchise of the principal streets of the borough to the Ambler Electric Railway Company, which is to extend from Hammondville to Ambler.

SIDNEY, N. Y.—Civil Engineer Eugene F. Musson, with his assistants, Will F. McCulloch, George Gray and Lloyd Shaw, began a preliminary survey of the route of the proposed Butternut Valley Electric Railroad from Sidney to Morris.

LAWRENCE, MASS.—Contractors Soule, Dillingham & Co. have signed a contract with the Lowell, Lawrence & Haverhill Street Railway Co. which calls for the completion of an electric road from Lawrence to Lowell within sixty days.

HARRISON, (P. O. Newark) N. J.—The Newark Passenger Railway Company and the Consolidated Traction Company are authorized to use electric motors as the propelling power of its cars and to erect the necessary poles and string wires.

GLENWOOD, PA.—A new power house is to be erected at Glenwood shortly by the Second Avenue Traction Company, which will supply power to the entire system between Market street and Turtle Creek. It will contain four dynamos of 450 h. p. each.

PELHAMVILLE, N. Y.—The people of Pelhamville are circulating a petition to be sent to the Union Railroad Company, of New York City, requesting that a line be constructed through the village, which will connect Pelhamville with Mt. Vernon and New Rochelle.

NEWTON, MASS.—At a special meeting of the Newton Aldermen the petition of the Newton & Boston Street Railway for a double track on the new Central Boulevard, from the Boston line to Washington street, Auburndale, was referred to the railroad committee.

ST. LOUIS, MO.—The Citizens' Railway Company is preparing to change its motive power from horses to electricity on its line from Kings Highway to Rinkelville. The line will be extended to the limits of St. Louis. C. N Duffy, 3820 Easton avenue, is secretary.

EASTON, PA.—It is said that the proprietors of the Easton & Bangor Electric Railway Company have determined to build their road as far as Martin's Creek. Engineers have been at work lately in the vicinity of Richmond and Mt. Pleasant surveying for the proposed line.

NEW YORK CITY, N. Y.—The trolley road of the Twenty-third and Twenty-fourth wards proposes to extend its lines all over the district. A line is to run through Tremont avenue from West Farms to Kingsbridge, and through One Hundred and Sixty-first street and Willis avenue.

WORCESTER, MASS.—At a special meeting of the Board of Aldermen the Consolidated Street Railway Company was given a hearing on its petition to extend its double track down Belmont street from Plantation to the lake. The Company was represented by President C. R. Pratt.

GOSHEN, N. Y.—It is believed that arrangements have been made by which the Middletown Goshen Traction Company will secure an entrance into Goshen. It is proposed that the road shall leave the highway near the Ryerson place on Goshen Hill, and go through the lands of Ryerson farm.

BROOKLYN, N. Y.—The Long Island Traction Company has decided to borrow $3,000,000 for the purpose of adding ninety miles to its present system. Collateral trust notes bearing a face value for this amount will be issued, dated August 1, 1894, to bear interest at 6 per cent. per annum and to mature in three years.

OAKLAND, CAL.—Judge Ogden has granted Receiver Frank J. Woodward, of the Highland Park & Fruitvale Railway, leave to borrow $18,000 on his certificates for the purpose of extending the line of the road from Thirteenth avenue and Eleventh street, in East Oakland, to Jefferson street, in Central Oakland.

HARTFORD, CONN.—The directors of the Hartford, Manchester & Rockville Tramway Company awarded the contract for building its line from the terminus of the Hartford Street Railway Company, in Burnside, to the Main street railway crossing, in Manchester, to George U. Vaughn and Fred P. Lay, of Springfield.

RUTHERFORD, N. J.—Delos E. Culver, representing the proposed electric railway from Rutherford to Newark, went before the Rutherford Borough Council and asked permission to submit a proposed ordinance giving the railway right of way through Park avenue, Rutherford. Permission to submit the ordinance was granted.

PHILADELPHIA, PA.—The Board of Highway Supervisors has received an application from the Market street, Richmond & Frankford Elevated Railway Company for permission to begin work north and northwest from Penn street and the Oxford turnpike to Cheltenham. The matter was referred to a committee, with power to act.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrow's Point Railroad Company will apply to Baltimore County authorities for additional privileges. It intends building an electric railroad to Sparrow's Point. The incorporators are George R. Willis, J. Sloan Haskins, Thomas B. Gatch, Levin F. Morris and John J. Forrester.

WESTMINSTER, MD.—The Westminster & Union Mills Electric Railway Company, lately noted as chartered to build an electrical railroad from Westminster to Union Mills, has organized with T. Herbert Shriver, of Union Mills, president, Charles E. Stewart, vice-president, William B. Thomas, treasurer, and Charles H. Vandeford, secretary.

SAVANNAH, GA.—Applications for an injunction and a receiver for the electric railway company of Savannah, Ga., has been filed. This company defaulted on its bonded interest in July and with the recent rate-cutting and competition with the city and suburban railway, has lost considerable money. There is little doubt but that a receiver will be appointed.

HAMILTON, O.—The Dayton, Cincinnati & Middletown Electric Traction Co. will at once proceed with the construction of its electric road between Cincinnati and Hamilton. Mr. W. C. Shepherd, of Hamilton, the company's attorney, says that the road will be completed by the first of January. The City Council will be asked for the right of way through Hamilton.

M'KEESPORT, PA.—A special meeting of the McKeesport & Versailles Cemetery Board has considered favorably the proposition of the McKeesport Railway Company to obtain ten feet of the cemetery ground along the stone retaining wall on Fifth avenue, as a right-of-way for its line to enter this city, and to reach the Baltimore and Ohio Railway depot by way of Jerome street.

PITTSBURGH, PA.—R. L. McCully, the engineer who had charge of the Pittsburgh & Mt. Lebanon Electric Railway, has completed the work, and the company will commence to lay the tracks immediately. The railway will run from the head of the Monongahela incline down to Grandview avenue to Scott, to Shannon, to Essex, and to Bridgeville. It will require about $100,000 to build the line.

CHARLOTTESVILLE, VA.—The City Council has granted an extension of the franchise to the Piedmont Improvement and Construction Company to build an electric car line in the principal streets of this city. Work will begin immediately. The president of the company is Hon. Joseph E. Willard; Capt. T. O. Troy is general manager, and the secretary and treasurer is Joseph E. Willard.

MEDIA, PA.—The Media, Middletown, Aston & Chester Trolley Company, which has been almost a year trying to get through Chester Township, commenced operations, the company having given the contract for surveying to Engineer Howland, who commenced work on August 23. Mr. Howland will make a complete set of plans, which can be used in the construction of the road, but they will first be used for getting estimates of the cost of the line.

WILLOW GROVE, PA.—The State Department at Harrisburg, has issued a charter to the Willow Grove & Hatboro Street Railway Company, capital $18,000. The line will run on the Hatboro and Warminster turnpike from its intersection at Willow Grove, to the line between Bucks and Montgomery Counties. The president is John H. Fow, of Philadelphia; directors, Arthur D. Markley, Samuel J. Garner, James Van Horn, O. F. C. Robinson and others, of Willow Grove.

WASHINGTON, D. C.—Preliminary drawings are being made by Engineer Wm. J. Upton and Architect W. B. Wood for a power house and a car barn for the Columbia Railroad Company, to be located in the immediate vicinity of the company's present office and stables. The power house will be of brick, one story and basement, 200x80, and will contain engine room, boiler room, oil and coal room. Steel trusses and an iron roof will be the features. The front part of the building will be spanned with an 80-foot truss and the back with two trusses, one 18 and the other 32 feet. The car house will be of brick, 125x200, and will contain the offices. No contracts have been let.

CAMDEN, N. J.—The West Jersey Traction Company is composed of Camden and Philadelphia capitalists, who have extensive plans for a trolley system which will connect all the towns along the Delaware River, from Burlington down to Camden. It owns a majority of the stock of the Haddonfield Turnpike Company, and now has a force of men at work building a trolley line from Camden through Colingswood to Haddonfield. They have also projected a line from Camden to Merchantville, Pensaukin and Moorestown. The company proposes to run its lines through Camden to the Kaighn's Point and Market street ferries, and also crosstown lines. This matter will be considered by the Camden City Council.

STROUDSBURG, PA.—Work has been started on the Delaware Valley Electric Railroad from Stroudsburg to Port Jervis, a distance of forty miles. This road runs through Pike county, Pa., and will be an important feeder to the D., L. & W. R. R., the N. Y., L. E. & W. R. R., and the N. Y., S. & W. R. R. The work is in charge of Charles E. Hague, of Philadelphia, as general manager, ably assisted by H. F. Sanville, as electrician, and assistant manager. The office of the company is at East Stroudsburg, where a corps of able engineers are busily working under the direction and supervision of Stewart Kennedy, C. E. The company is about closing orders for apparatus, orders having been placed for rails, ties, etc.

SOUTH ORANGE, N. J.—The Village Improvement Society is making a commendable effort to secure the benefits of an electric road without its disadvantages. A line from Orange is projected, but the people of South Orange are unwilling to give it entrance into their village by any of the residence streets or allow a new street to be laid out through the low lands, which would only result in the spoiling of their beautiful valley by the cheap class of buildings which would be sure to follow the route. The village is seeking to solve the question by compelling the railway company which receives the franchise to convert the lowlands into a park and run its road as a private way, fenced in and avoiding grade crossings. This would give a chance for very high speeds.

MERCED, CAL.—A Chicago syndicate proposes to build an electric railway from Merced into the Great Yosemite Valley. It guarantees to build the road from Merced and to furnish the city of Merced with 1000 electrical horse-power if said city will bond itself for two hundred thousand dollars in their favor. The first power station would be about twenty-five miles distant from Merced, utilizing the water power of the Merced River, which rises in the Yosemite Valley. The railroad will run along the south bank of the river into the Valley, and the power stations placed at convenient locations along the river, utilizing the water power of the river at each station. The distance from Merced into the Yosemite Valley by this route is about sixty miles. Such a railroad would develop many valuable industries. It taps the great timber belt of the Sierra Nevada Mountains. It passes great mountains of solid granite and marble. It is in close proximity to the great gold mines of Mariposa County, and crosses the great "Mother Lode." Many of the low grade mines can be profitably worked by electricity that cannot be worked by steam. The road is over a most picturesque route all the way from the great San Joaquin Valley into the high Sierras. Tourists will thus be able to view the valley in winter as well as in summer by a most delightful and rapid route.

Personal Notes.

MR. E. ARNOLD, whose name is familiar to the readers of The Electrical World, and who was formerly one of the engineers of the Oerlikon Works, has been appointed professor of electricity at the Technical High School at Carlsruhe.

LORD KELVIN has been awarded the Societe d'Encouragement grand gold medal for 1894. This medal is awarded to Frenchmen or foreigners whose labors have had the greatest influence during the preceding six years on the progress of French industry.

MR. C. H. CHALMERS, of St. Paul, Minn., we learn, was the author of the excellent paper on "The Modern Dynamo" read at the St. Paul Convention of the Northwestern Electrical Association, and which in our columns was credited to Mr. Gilbert Donaldson. We regret this error, which was copied from the stenographic report of the Convention.

Trade and Industrial Notes.

THE AUTOMATIC ELECTRIC REGULATOR COMPANY, Lowell, Mich., has been formed to manufacture an electric governor. Mr. C. S. English is the electrical engineer of the company.

THE ACME FILTER COMPANY, of St. Louis, has issued a very neat and readable leaflet on its oil filter, in which is given a long list of the electrical plants where this clever and useful device is in service.

THE GOUBERT MANUFACTURING COMPANY, New York, besides the Stratton separators described elsewhere, has also supplied Goubert feed water heaters of the latest improved type for the new plant of the Philadelphia Traction Company, aggregating 12,000 horse-power.

THE D. F. SWEET ELECTRICAL MANUFACTURING COMPANY, of Grand Rapids, Mich., has placed on the market a new and improved "Limit Switch," designed for motor circuits, and which acts at once as a switch and fuse plug. It is meeting with great favor, and will soon be seen in different sections of the country.

THE UNION METALLIC CARTRIDGE COMPANY, of Bridgeport, Conn., has placed the order for three large buildings with the Berlin Iron Bridge Co., of East Berlin, Conn. The Larchmont Electric Company, of Mamaroneck, N. Y., has also placed the contract of its power station with the Berlin Iron Bridge Company. The building will be 50 ft. wide and 90 ft. long.

THE PHOSPHOR-BRONZE SMELTING COMPANY, Limited, 2200 Washington avenue, Philadelphia, has issued price list No. 9 of its products, which include wire from No. 4-0 to No. 36, and of round, flat and square sections. There are also lists of telephone and telegraph phosphor-bronze wire, phosphor-bronze alloys for castings, bearings and plates, and rods of metal for various purposes.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, O., has nearly completed its new factory addition which will increase the daily output to from six to eight thousand lamps. With its ability to manufacture at low cost, and the high reputation already achieved for the special coiled filament lamp, they say the "Buckeye" will be hustled into central stations and isolated plants in a lively manner.

THE ATLAS ENGINE WORKS, Indianapolis, Ind., of which Edward P. Hampson & Co., 36 Cortlandt street, New York, are agent have issued a large-

page catalogue of their steam engines and boilers. The catalogue is tastefully gotten up and well-printed on paper of extra quality. Many forms of horizontal engines are illustrated, of which we note in particular several types of automatic heavy-duty engines. A number of types of stationary and portable boilers are also shown.

THE D'UNGER LONG-DISTANCE TELEPHONE COMPANY, of Chicago, Ill., in a recent communication state that one of their instruments, which was in use every day except Sunday for four years, transmitted speech more clearly when taken down than the day it was put up, and was never touched during that time, save to charge the cell. In explaination of this the D'Unger Company claim that no self-cleaning, voice strengthening or voice wave reducing telephone can be made without a lever, to the use of which the company claims the sole right.

THE OHIO BRASS CO. Mansfield, Ohio, is gratified that the superior workmanship and quality of the metal employed in the manufacture of its railway motor bearings are receiving due appreciation and resulting in a large increase of sales, its patrons including many of the largest roads in the country. These bearings are made of guaranteed bell metal, and are turned and trued up, and milled by special machines lately installed for this purpose. The extraordinary care taken with the finish of these insures a perfect fit, and an even and smooth bearing for the shaft.

A CORRECTION.—In our issue of Aug. 18, page 164, the statement was made that Henry R. Worthington had placed an order through Manning, Maxwell & Moore for a Shaw electric traveling crane, this crane to supplement an electric crane of another make. We are advised by the Morgan Engineering Company, of Alliance, O., that the crane ordered from the Shaw Company did not supplement a Morgan crane or, in fact, any crane, as the following extract from a letter received by the Morgan Engineering Company from Charles C. Worthington, President of the Henry R. Worthington Hydraulic Works: "The crane we recently ordered of the Shaw Company is to be used in our loam foundry. The crane you built for us is at work in our green sand foundry, which is a separate building. Your crane is doing good work, and we have no complaints to make of its performance."

CHAS. E. GREGORY & CO., 47 & 49 S. Jefferson street, Chicago, Ill., report the following list of recent trade sales: Schneider Co., Garner, Ia., one 60-light United States plant; Rud. Lafferty, Chicago, one 1 h. p. C & C arc motor; Gardner-Morgan Electrc Company, Chicago, one 10 h. p. Detroit motor; J. W. Alber, Chicago, one 10 h. p. Crocker-Wheeler motor; Crane Elevator Company, Chicago, one 25 kw. Westinghouse motor; C. C. Travis, Lavon, Ill., one 100-light Excelsior dynamo; Wilson & Jackson, Chicago, one 8-light arc plant, one 10 h. p. engine; C. R. Celaghorn, Conemaugh, Penn., one 5 h. p. Crocker-Wheeler motor; R. Roach, Chicago, one 210-light Edison dynamo; Garibaldi & Cuneo, Chicago, h. p. C & C motor; Seeger, Guernsey & Company, one City of Mexico, Mexico, one 50-light U. S. dynamo, one 100-light U. S. dynamo, and one 10 h. p. Crocker-Wheeler motor; Geo. Cutter, Chicago, one 1 h. p. Crocker-Wheeler motor, one 450-light dynamo; Pontiac E.L. H. & P. Company, Pontiac, Ill., one ½ h. p. motor; Jorden Show Printing Company, Chicago, one 10 h. p. Edison motor; Capt. E. E. Napier, Steamer Mactawa, one 5-light Sperry arc plant; Plamondon Mfg. Company, Chicago, one 60-light United States plant; C. Shotte, Chicago, one 2,000-light Edison dynamo; Hatch Cutlery Co., Buchanan, Mich., one 25 kw. Edison motor; University of Colorado, Boulder, Col., one 100-light United States plant; Northwest Fixture Company, Seattle, Wash., one 5 h. p. Sprague motor; Tuscaloosa Gas & Electric Light Company, Tuscaloosa, Ala., one 100-light U. S.; Champaign & Urbana Railway Company, Champaign, Ill., one 10 h. p. T. H. motor; Tappan Steam Pump Company, Chicago, one 6 h. p. Crocker-Wheeler motor; Crane Elevator Company, one 1 h. p. Crocker-Wheeler motor; Windemere Hotel, Chicago, one 3 h. p. Sprague motor, D. S. Huff, Morris, Ill., one 50-light U. S. dynamo, Charleston T. H. Electric Company, Charleston, Ill., one 1 h. p. Crocker-Wheeler; Receivers of the Penn. Steel Company, Steelton, Pa., 16 Standard arc lamps; Kug, Nathan & Fischer, Chicago, two Ward arc lamps; Elmer P. Morris, Indianapolis, Ind., six Ward arc lamps; Robbins Electric Company, Pittsburg, Pa., four Edison arc lamps.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., reports a marked and very satisfactory increase in orders since the passing of the new tariff bill was perfectly assured. Its sales for lighting apparatus, alone since then are as follows: New Davidson Theatre, Milwaukee, two 1,000-light dynamos; A. W. Perry, Boston, Mass. (fifth order), 350-light one dynamo; Hotel Minot, New York City, one 650-light dynamo; Hoboken Quartet Club, Hoboken, N. J., one 150-light dynamo; Henry Reinhardt, New York City, one 100-light dynamo; E. P. Gleason Manufacturing Company, New York City, one 250-light dynamo; Pisataqua Woolen Company, Guilford, Me., one 600-light dynamo; Danvers Insane Asylum, Danvers, Mass., one 250-light dynamo; Newport Gas Light Company, Newport, R. I., one 250-light dynamo; State Almshouse, Tewksbury, Mass., one 600-light dynamo; Whittenton Manufacturing Company, Taunton, Mass., one 100-light dynamo; Weise Bros., Moline, Ill., one 250-light dynamo; Chambers Electric Light and Power Company, Truro, N. S., one 500 light dynamo; Union Central Life Insurance Building, Buffalo (third order), one 250-light dynamo; Beck Brewing Company, Buffalo, N. Y., one 600-light dynamo; Comstock Construction Company, Chicago, Ill., one 250-light dynamo; Gallagher Bros., Meridian, Miss. (third order), one 100-light dynamo; New Ford's Opera House, Washington, D. C., one 450-light dynamo; Jones Bros.' Electric Company, Cincinnati, O. (seventh order), one 50-h. p., 220-volt generator; New Pittsburg Coal Company, New Pittsburg, O., one 60-kw, 220-volt generator; Morris Coal Company, Sand Run, O., one 60-kw. 220-volt generator; Harry S. Smith & Company, Philadelphia, Pa., two 45-kw, direct connected generators; J. Holt Gates, Chicago, Ill., one 250-light dynamo; J. Holt Gates, Chicago, Ill., two 60-kw, belted generators; J. Holt Gates, Chicago, Ill., one 60-kw, direct connected generator. The Mather Company also reports a very large sale of its new Manchester type slow speed stationary motors, in sizes from 3 to 50 h. p. It has had so much success in the introduction of these motors that it has so far been unable to keep up with its orders for this class of apparatus.

Business Notices.

WHAT WILL THE NEW YORK CENTRAL DO NEXT?—After having his thirst whetted, like a tiger by the taste of blood, by the wonderful performances of Engine No. 999, the genie who presides over the transportation department of the New York Central Railroad is rampant again, and laboring persistently to find means of attaining the speed of lightning. He is at work in his cell, by stealth and at midnight, and before many moons have passed we expect to see a terrible apparition coming up the Hudson River like the war chariot of Jove. We may expect a monster engine, with double boilers of enormous power and wheels as tall as a shot tower, which will trot up to Albany in an hour, skip over to Utica or Syracuse at half an hour schedules and cover the distance from New York to Buffalo in threee hours. Then we shall need some means of artificial respiration.—Medford (Mass.) "Mercury."

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 28, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

525,001. INSULATOR; Leonard W. Bradley, Cleveland, O. Application filed February 13, 1894. An insulator composed of two parts, each part being provided with a central screw passage and the meeting faces of said parts having coinciding grooves which begin on approximately straight lines near the edges and curve near the centre of the parts to avoid the central aperture; the walls of said grooves being adapted to engage the upper and lower portions respectively of the electric wire and hold it firmly and prevent it from slipping longitudinally.

525,007. MANUFACTURE OF CARBON FILAMENTS; Thomas A. Edison, Llewellyn Park, N. J. Application filed December 15, 1886. The method of making filaments for incandescent electric lamps, which consists in forming a core of a substance soluble in water, coating the core with one or more layers of carbonizable material, dissolving the core in water and finally carbonizing the hollow filament.

525,013. FEED ALARM FOR CARDING MACHINES; William W. Gordon, Hazardville, and Thomas F. Pye, of Hartford, Conn. Application filed August 26, 1893. In combination in a carding or like machine, an electric alarm, a push button for controlling the electric current, a swinging lever adapted to operate the button, a receiver having a pivoted feed board, and a connecting mechanism between the lever and feed board whereby the former is caused to engage the button and sound the alarm.

525,015. TROLLEY. Naaman W Haskins, Brooklyn, N. Y. Application filed December 1, 1893. A trolley for engagement with a single electric conductor consisting of a plurality of grooved annular bearings formed at right angles to a common axis, the side walls of each groove, forming a separate bearing capable of transmitting the current to an electrical conductor common to all the flanges.

525,016. TROLLEY-WIRE SWITCH AND CROSSING; Naaman W. Haskins, Brooklyn, N. Y. Application filed April 23, 1894. In combination with a trolley consisting of a plurality of grooved annular bearings, an electrical conductor for trolley lines formed with notches or grooves at or adjoining its intersection with a similar conductor, said notches or grooves coinciding in position with the paths of the several flanges upon the said trolley.

525,017. STORAGE BATTERY; Henry K. Hess, Syracuse, N. Y. Application filed October 11, 1892. In a battery, the combination with a conducting frame or grid, and separated layers of active material applied to said conducting frame or grid, of a layer of quartz-sand interposed between the layers of the active material, and having the separate grains or particles thereof held together by non-electric-conducting adhesive material, layers of non-electric-conducting porous material at the outside of the layers of active material, and layers of quartz-sand at the outside of said layers of non-electric-conducting porous material, and having the separate grains or particles thereof held together by non-electric-conducting adhesive material.

525,018 STORAGE BATTERY; Henry K. Hess, of Syracuse N Y Application filed February 13, 1893. In a storage battery, the combination with a body of active material; of a pair of perforated electric conductors arranged on opposite sides of said body of active material, and electrically connected thereto, and a non-electric conducting material arranged in the perforations of the electric-conductors and consisting of quartz sand having its separate grains or particles held together by a non-electric-conducting material.

525,020. ELECTRICAL FIRE ALARM APPARATUS; Ernst Waldemar Jungner, Stockholm, Sweden. Application filed November 8, 1893. In thermo electric fire alarm the combination with a normally closed thermo-electric-circuit, a relay therein composed of four solenoids arranged in pairs and provided with tubular glass cores, and a normally interrupted signalling circuit, of circuit closing devices comprising a fixed contact connected with one of the terminals of the signal circuit, a pair of magnets projecting into the cores of oppositely arranged solenoids a support for said magnets suspended freely between the solenoids, and a contact on said support connected with the other terminal of the signalling circuit and adapted to co-operate with the aforesaid fixed contact to close said circuit when the magnet support is vibrated by current passing through the solenoids

525,034. ELECTRIC ARC LAMP; Elihu Thomson, Lynn, Mass. Application filed January 24, 1894. In an electric arc lamp, a derived circuit coil tending to draw the electrodes together, a spring opposing the coil, a contact actuated by the coil, and the spring, a circuit controlled by the con-

tact magnet in such circuit, and a detent actuated by the magnet, such detent controlling the feed of the electrode.

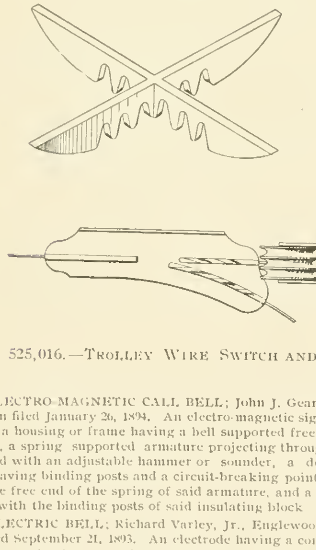
525,035. ELECTRIC ARC LAMP; Elihu Thomson, Swampscott, Mass. Application filed May 16, 1894. In an electric arc lamp a series coil, a core for such coil, a second coil in inductive relation to the series coil, a magnet in the circuit of such second coil, a detent actuated by the magnet, a frame connected to the core of the series coil and containing the gearing, a rack-rod meshing with the gearing, and a contact actuated by the movement of the core or frame and arranged and adapted to complete the circuit through the second coil upon the descent of the core.

525,037. MEANS FOR LIMITING THE TENSION OF DRIVING SPRINGS; Paul Wendelobe, New York, N. Y. Application filed February 27, 1894. In a printing telegraph or other clockwork instrument, the combination of a driving spring, a step-by-step mechanism for winding the same, and detent devices therefore provided with a resilient member arranged to give whenever the driving-spring exerts the greater power.

525,082. TRAIN ROBBER ALARM; Max S. Levy, Kansas City, Mo. Application filed March 27, 1894. In a train-robber alarm, the combination with a vertically movable platform in the engine cab, catches depending from the floor of the cab, and a sliding frame carried by and normally supporting the movable platform in its raised position by engaging the said catches, of spring-pressed doors, and bells, located in the various cars, electro-magnets adjacent to said doors and bells, electrical conductors, and means to operate the sliding frame and disengaging the same from said catches, allow said platform to move downward, and thereby cause the completion of an electrical circuit to energize the electro-magnets to allow the doors to operate, and to sound the alarm.

525,108. ELECTRIC-MOTOR; Abraham V. Meserole, New York, N. Y. Application filed January 8, 1894. In an electric motor, a fixed drum-shaped field ring having an odd number of coils exceeding by at least three the number of the armature poles and electrically connected in series, in combination with a bi-polar armature rotating within said field ring and having crescent-shaped pole extensions.

525,134. CIRCUIT-BREAKER; Cumings C. Chesney, Pittsfield, Mass. Application filed July 6, 1894. The combination with the terminal plates or contacts of an electric circuit, of a pivoted bride-piece adapted to be forced and maintained in engagement with said terminals, a pivoted weight engaging with the bridge-piece but having a determined range of movement independent of the same, and a tripping device for holding the weight in an elevated position against the force of gravity.



No. 525,016.—Trolley Wire Switch and Crossing.

525,145. ELECTRO-MAGNETIC CALL BELL; John J. Geary, Chester, Pa. Application filed January 26, 1894. An electro-magnetic signalling device, comprising a housing or frame having a bell supported free thereof, an electro-magnet, a spring supported armature projecting through said housing and provided with an adjustable hammer or sounder, a detachable insulated block having binding posts and a circuit-breaking point adapted to contact with the free end of the spring of said armature, and a battery circuit connected with the binding posts of said insulating block.

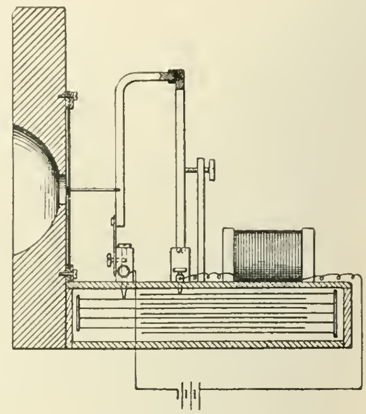
525,169. ELECTRIC BELL; Richard Varley, Jr., Englewood, N. J. Application filed September 21, 1893. An electrode having a contact point, in combination with the second electrode and a septum, and a clamp for securing the septum around its edges, there being a hole through the septum for the passage of the contact point, so that both electrodes are within the cavity inclosed by the septum.

525,201. TELEPHONE TRANSMITTER; John Goodman and Henry M. Goodman, Louisville, Ky. Application filed May 1, 1894. A telephone transmitter, consisting essentially of two magnets having their opposite poles opposed to each other, a mass of magnetic material in a comminuted state between such poles, and a vibratory diaphragm connected with one of said magnets, the movable magnet being mechanically related to the diaphragm upon the principle of a lever, whereby the movements of said magnet may be augmented or diminished relatively to the movements of the diaphragm.

525,235. DRY BATTERY; John I. Solomon, New York, N. Y. Application filed April 11, 1894. In a dry battery, the combination of a cell made of glass, a curved plate of zinc within the cell, a carbon rod inserted in the cell within the curved zinc plate and provided with a thick coating formed of a mixture of black oxide of manganese, granulated carbon and chloride of zinc, a granular porous filling placed within and around the zinc plate and around the carbon rod, a seal closing the top of the jar and surrounding the carbon rod, a wire leading through the seal to the zinc plate, and a ventilaitng tube passing through the seal to the porous filling.

525,266. CIRCUIT CLOSING DEVICE; John J. Geary, Chester, Pa. Application filed February 5, 1894. The combination with a recessed member and a hinged member of a device provided with metallic and insulating plates, plugs or disks and strips and binding screws, a push, stem or rod adjustably seating with a helical or coiled spring, a contact provided with a split helix or ring detachably engaging said spring and having flaring metal arms and a battery circuit provided with an audible signal device.

525,290. ELECTRICAL RAILROAD SIGNAL; William F. Seymour, Mansfield, O. Application filed June 30, 1894. The combination with the rails of a track at a crossing, of feed wires connected at their ends to said rails a limited distance at each side of the crossing, connecting wires connecting said feed wires with the respective rails at the joints thereof, a post at the

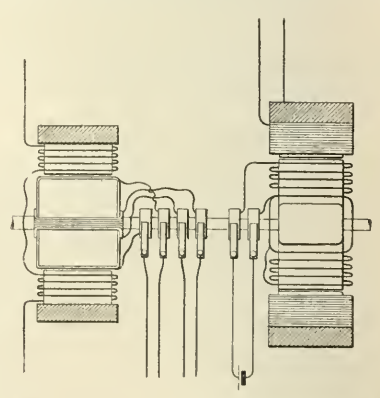


No. 525,201.—Telephone Transmitter.

crossing, a bell on said post, a bracket secured to the post, a battery on said bracket, and wires connecting said bell and battery in circuit with said feed wires.

525,291. ELECTRIC ALARM LOCK; John Slater, Hutchins, Pa. Application filed November 9, 1893. An alarm lock having an actuating spindle with a lug which projects therefrom, a bolt adapted to be moved by said lug and spindle, together with pivoted plates having intermeshing teeth, said plates being connected to a binding post and adapted to contact with a plate insulated therefrom and attached to another binding post.

525,293. INCANDESCENT ELECTRIC LAMP CUT-OUT; Walter F. Smith, Philadelphia, Pa. Application filed August 23, 1889. In an incandescent electric lamp, a shunt circuit, a substance of high electrical resistance



No. 525,312. Apparatus for Changing Period and Phase of Alternating Currents.

readily melting or softening interposed in said circuit, a movable pin contacting with said substance and a lever held in contact with said pin and short circulating the lamp by the melting or softening of said substance.

525,312. METHOD OF AN APPARATUS FOR CHANGING PERIOD AND PHASE OF ALTERNATNG CURRENTS; Charles S. Bradley, Avon, N. Y. Application filed July 10, 1893. Method of altering the frequency of an alternating current consisting in creating an alternating magnetic field by such current, and rotating in said field a conductor or circuit so as to pass its poles at a fractional part of the rate of the alternating current.

525,315. ROSETTE FOR ELECTRIC LIGHT WIRES; David J. Cartwright, Boston, Mass. A rosette having an internal chamber, a central hole through which the lamp cord passes to the said internal chamber, a hole or opening, a slot connecting the holes, the inner end of the hole or opening being slightly enlarged, and a raised ring at the inner end of said hole.

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CONTENTS.

THE DISCHARGE OF MAGNETISM.

We print elsewhere a paper by Mr. M. A. Agelesto on the "Discharge of Magnetism," which gives, in the form of curves, the results of a series of careful experiments relating to the discharge of magnetism from the various portions of an iron core. The object of the paper is rather to give the data of the experiments than to draw conclusions from them, but several consequences made evident are pointed out. Among these are that residual magnetism seems to be principally confined to the centre of the core, and that magnetic discharges under certain conditions are oscillatory in character. The subject is one of importance in connection with alternating current working, and several of the phenomena encountered may have a bearing in the case of transformers.

THE ELECTRIC FURNACE.

The electrical process by means of which aluminum is now manufactured promises to be extended to the cheaper production of some of the rarer metals and combinations. M. Moissan, in some recent communications to the *Comptes Rendus* of the French Academy of Sciences, gives the details of some work in this direction, which has resulted in the production of several compounds heretofore beyond the reach of the usual chemical processes, among others of carbon boride, which can be used in place of the diamond for cutting and polishing. When we consider that aluminum, which was formerly much more valuable than gold, is now produced for considerably less than a dollar a pound, the great possibilities of the process are evident. Some of the rarer metals and compounds posess valuable qualities which heretofore could not be utilized on account of the expense of the process necessary to isolate them, and the attention now given to the subject promises to make some, at least, of these commercially available.

TRANSFORMING FREQUENCIES.

For the laboratory and for experimental purposes a method by means of which an alternating current of any frequency may be obtained is of obvious value, and elsewhere in this issue Lieut. Patten shows how this may be done. As will be seen, the method consists in turning an armature in a rotary field in a direction opposite to that in which the field rotates. If the two speeds are equal there will be a frequency of double the fundamental one, while with the armature at rest it merely acts as a transformer, and gives the fundamental frequency. By means of another combination described, any frequency desired below the fundamental one may be obtained, even as low as a single period per second. We may note in this connection that after the article by Lieut. Patten was in our hands, a patent was granted (August 28, 1894) to Mr. C. S. Bradley for a method of transforming frequencies of alternating currents, which consists in creating an alternating magnetic field and rotating in it a circuit so as to pass the poles at a fractional part of the rate of the alternating current itself. This seems to be somewhat similar to one of the methods described by Lieut. Patten. An interesting experiment would be to attach collectors to the armature winding of a closed-circuit or multiphase motor in order to determine the character of the current that would result. The resistance of the exterior circuit would have to be small in order to not derange the working of the motor.

HELMHOLTZ.

By the death of Prof. von Helmholtz science loses one of its master minds and the nineteenth century one of its greatest figures. While the weight of great age—which numbered three years more than the allotted three-score-and-ten—had brought to an end the powerful mental activity which accomplished such wonders, yet his influ-

ence over current scientific thought remained, and the dominion of his personality over the minds of his pupils was to the last one of the great educational forces of Germany. Helmholtz's greatest claim to fame will rest on his demonstration of the law of the conservation of energy, which is, perhaps, only rivalled by Newton's discovery of the laws of gravitation. The influence of this theory on scientific thought has, however, been greater than Newton's achievement, for all science has not only been remodelled in accordance with it but its limits thereby indefinitely extended. In the purely electrical field the work of Helmholtz has also been of the greatest value, though confined principally to the domain of higher theory. He was the first to recognize the supreme merit of the work of Faraday, and several of his most valuable papers are devoted to Faraday's theories, one of which, giving the results of an examination of the Faradic and action-at-a-distance hypotheses as to forces, pronounced in favor of the former when it had no standing in the scientific world. His investigations in the mechanism of sound resulted in our modern wave theories, whose applications in electricity are now assuming so much importance.

ELECTRIC DISTRIBUTION FROM SUB-STATIONS.

Elsewhere we give a synopsis of the report of the electrical engineer of the Zurich municipal electric lighting station, which contains data of the cost of installation of this system, whose feature is distribution to consumers from sub-stations. As will be seen in our very full account of this plant which appeared in The Electrical World of June 2 and June 9, 1894, the alternating current is generated at a voltage of 2,000, transmitted to a central distributing station one and one-half miles distant, whence lines go to the eighth transformer sub-stations in the centre of their respective lighting districts. From these sub-stations the current is distributed for lighting and motors by a three-wire system with an E. M. F. of 100 volts on each side. A notable point about the installation is the careful manner in which it was worked out from an engineering standpoint. Considerations of first cost have not been allowed to interfere with obtaining a perfectly reliable system, and even if the underground distribution had not been required by the city authorities, its advantage, both practically and from the low cost of maintenance, have been demonstrated, though the outlay for the mains was very large. From the figures given it will be seen that the cost per kilowatt on the basis of lamps installed is about $310, or $230 per kilowatt of station capacity, which merely includes the electrical equipment. If the cost of buildings, turbines, water improvements, etc., were added, the total cost would be little if any less than that of American steam central stations, which average more than $500 per kilowatt installed. The load factors, however, are much higher than in this country, averaging .45 for the entire year and reaching .58 during the winter months. These figures result from the policy of discriminating against customers who use the light only during a few hours. To operate a central station under efficient conditions, such a policy is necessary, and will eventually have to be generally adopted. It may not be a popular course to pursue, but it is absurd from a business point of view to lose the profit derived from one set of customers by connecting up at the same rate others whose demands for current only occur at the time of maximum load.

ELECTRICAL NETWORKS FOR AGRICULTURAL DISTRICTS.

The Digest refers to an article in an English contemporary on the employment of electric traction on country roads, which has a bearing on the discussion of the subject which has appeared in an Ohio State report. In the latter the adoption of electric traction and the entire displacement through it of the present means of transportation on country roads are strongly advocated. Some figures of a general character are given to show that the cost and maintenance of the track would not be much, if any, greater than that of good macadamized roads, nor would the cost of operation be greater than would be saved in time and the keep of horses. The entire question is a financial one, for there are to be no engineering difficulties to overcome. A good way to arrive at some decision would be to estimate the cost of a system for some agricultural district and also the cost of operation, and then determine the annual pro rata cost to the farmers who would presumably be affected. If this were done we feel convinced that the impracticability of the scheme would become very apparent. It is one thing to estimate in dollars and cents the time spent by farmers in repairing roads and in hauling, and quite another to have them pay this amount in money for the labor saved, for what they would thus gain in time is not necessarily a gain in money. Even assuming that some agricultural operations would be carried on by electric power derived from the trolley lines, yet horses would still have to be employed. The saving, therefore, to the farmer would be largely in time, which in his case would have usually no money value, in repairs to wagons, some saving from fewer horses and perhaps in other incidentals. With twelve farmers to a mile of electric road the total would be insignificant in comparison to the capital charges, maintenance and operation, for the freight would probably not average a light load daily per mile of road. Outlying farmers would of course add to the traffic, but in any case it seems to be entirely unreasonable that any such system as that proposed in Ohio could pay in view of the close margin of profit now found in the operation of inter-urban electric roads in thickly settled districts.

English Journalism.

In our issue of August 4, we commented editorially on some remarks made by the London "Electrical Review" on the American Republic. In the issue of that journal just received it replies as follows: "The Electrical World takes us to task because we commented unfavorably upon the mixing up of a mechanical paper with politics, the occasion being taken to make some rather extravagant claims for 'man's greatest political institution,' as coeval with the steam engine in birth. We ventured to think the juxtaposition was not a happy one, for the political institution has certainly not prevented the social evils of the Old World being reproduced with increased virulence in the New. To argue from this that we were carping at America or Americans is mere childishness. The very fact that our columns contained in the same issue three leading technical articles of American origin, is, we think, quite a sufficient proof of our respect for what Americans have done and are doing. What we objected to was the dragging in of politics at all. American journals would probably give us quite as severe a handling were we to claim as extravagantly for that political institution of our own country which is the descendent of that little garden party on Runnymede, of June 19th, A. D. 1215, and which certainly was productive of very valuable results to both ourselves and Americans. Quite a number of our readers look on the institution as a failure to-day, but do not admit that England is a failure; neither did we say that America was a gigantic failure. Had we done so we would certainly have apologized, and as it is we are sorry our contemporary has so misread what we had to say and has failed to understand that a country may teem with political failures and yet be far from a failure itself. We really think our contemporary is a little unreasonable and considerably unjust in the way it twists what we did say into an attack on America. As well argue that London is a fraud because it is unfortunately saddled with a bad system of government by 'bumble.'" We are pleased to see this; whether we were unreasonable and unjust, we leave to others to decide by comparing our editorial with the original remarks in the London "Electrical Review," July 13, page 53, near bottom of second column.

A Peculiar Phenomenon.

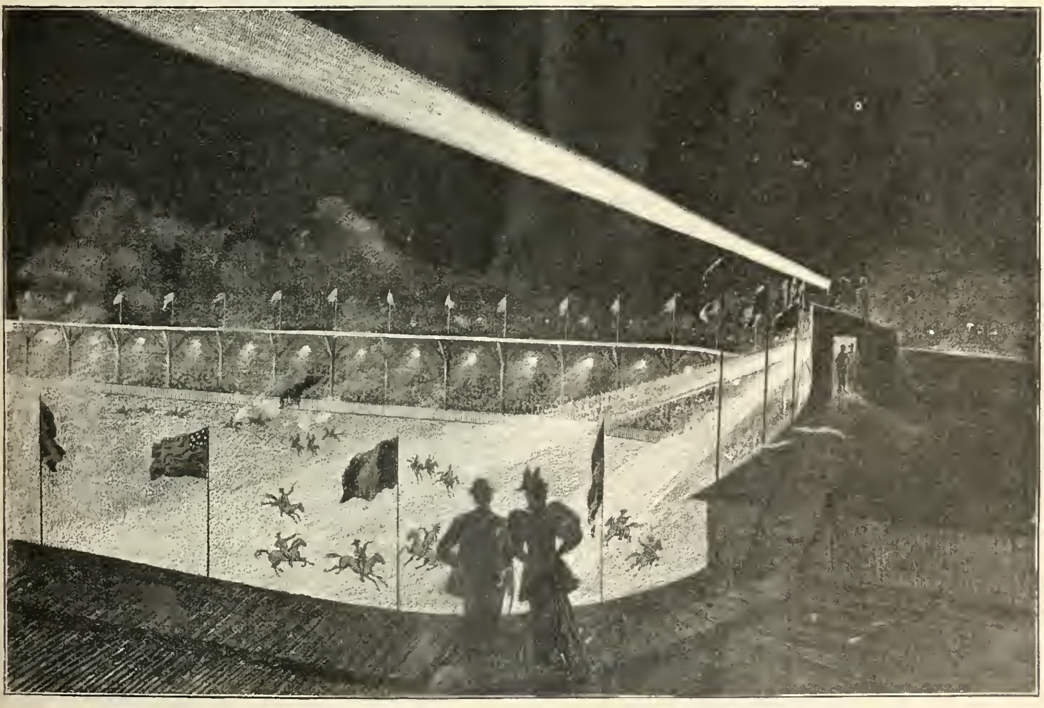
While in Nova Scotia last summer a correspondent relates that he had occasion to use very frequently the telephone line from Digby to Westport, a distance of about fifty miles. The line is a single iron wire with earth return. The instruments used are ordinary Bell short distance telephones. There are no other wires within fifty miles. Whenever there was an aurora or an electrical storm, he noticed the following phenomena: A person talking at the west end of line could be heard quite distinctly at the east end. But the person at the east end could not be heard at the west end at all, and the conversation would have to be repeated in the centre of line. At normal conditions of the weather conversations could be carried on distinctly in both directions, but always with an advantage from west to east. There is no question, he states, about the instruments, as they were exchanged without any change in the working being noticed.

In response to an invitation from the Edison Electric Illuminating Company of Brooklyn, over 200 of the members of the New York Electrical Society and their friends made a journey to Ambrose Park, last week, and after examining the electrical plant of the "Buffalo Bill Wild West Show," repaired to the roof of the grand-stand, where seats had been especially arranged for them to view the performance. From this position the manipulation of the arena lights could be watched to better advantage and the controlling apparatus in the "Texas" inspected and explained. The evolutions of the military, and, in fact, the majority of the several acts, are more beautiful as one looks down upon them from this elevation. At times the arena becomes a veritable kaleidoscope and the visitor is startled at the recklessness exhibited by these daring riders. The evening was fairly clear and bright and at the close of the entertainment the members were of one mind as to the success which has been attained in the electric illumination of "Buffalo Bill's Wild West."

It is seldom that so difficult a problem in lighting presents itself as that which confronted Messrs. Cody & Salisbury when they prepared to open their famous "Buffalo Bill's Wild West" at the World's Fair last year. For a successful evening performance they found it necessary to illuminate about two acres of ground, composing the arena, so that a newspaper could be easily read at any point. The hundreds of thousands who visited their show at Chicago well know how successfully it was accomplished.

With the close of the season at the World's Fair the proprietors decided to establish the show in Brooklyn, with a view to making it a permanent place of entertainment. A suitable plot was secured, covering the section between Thirty-fifth and Thirty-ninth streets and Third avenue and the Harbor, comprising some twenty acres in all. The area has been enclosed with a high fence of specially rolled corrugated steel, the same material being used for the sheathing and roofing of all buildings erected. It was here, with a much larger arena than in Chicago, covering about two and one-half acres, that a still more difficult problem of lighting presented itself. The general plan of the grounds, is shown in one of the accompanying illustrations, and the electrical circuits are indicated thereon.

The electrical installation was put in and is being maintained by the Edison Illuminating Company of Brooklyn, the work having been carried on under the personal supervision of General Superintendent W. S. Barstow. As the contract between Messrs. Cody & Salisbury and the Edison company for lighting the grounds and arena was made for a period of only six months, the plant was not built with a view to permanency. The material and construction, however, is very much better than the average plant built for a long period of service.



The Buffalo Bill Wild West Show at Night as Seen from the Roof of the Grand Stand.

The power-house, a plan of which is shown below, is of mill construction covered with specially rolled sheet steel; it is 48 feet wide by 72 feet long, and 30 feet in height. About one-third of this space is given up to the two 300 h. p. Morin Climax vertical water tube boilers, carrying a working pressure of 135 pounds to the square inch. A Worthington duplex boiler feed pump is used, and there

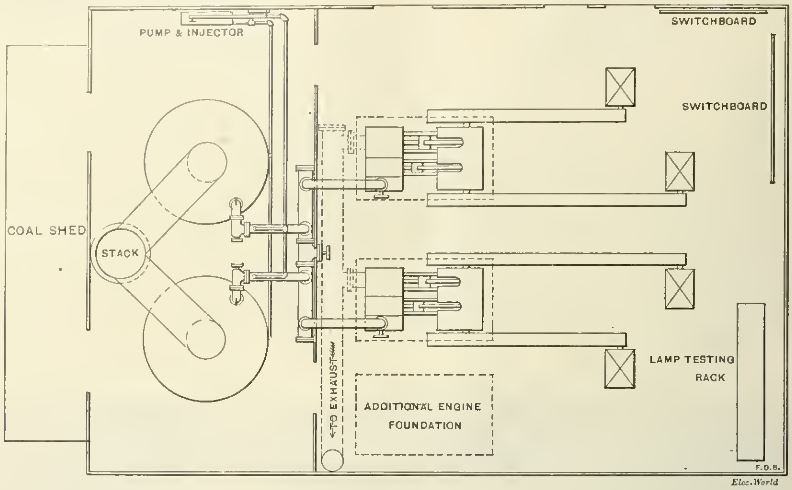
is a Korting universal injector for use in case of the pump becoming disabled.

Two 250 h. p. cross compound non-condensing Ball engines are used, transmitting power through four 16-inch double leather belts to as many 80 kw. Edison direct current generators operating at 125 volts.

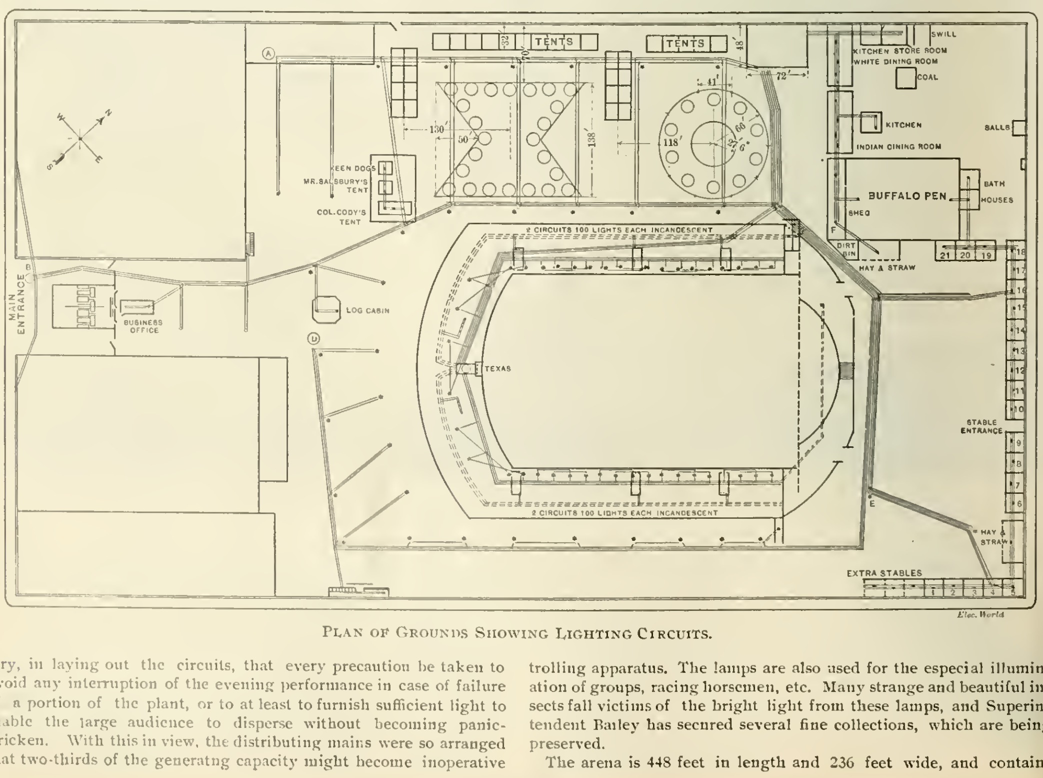
The results have been so satisfactory to Messrs. Cody & Salisbury that the contract with the Edison company for lighting has been renewed, and another engine and condensing facilities will be added to the plant for next season. There being no gas upon the grounds, this plant is called upon to furnish all light. It was therefore necessary, in laying out the circuits, that every precaution be taken to avoid any interruption of the evening performance in case of failure of a portion of the plant, or to at least to furnish sufficient light to enable the large audience to disperse without becoming panic-stricken. With this in view, the distributing mains were so arranged that two-thirds of the generatng capacity might become inoperative and yet maintain sufficient light within the grand-stand to avoid any possibility of a panic which would naturally result from total darkness.

There are three search lights in use, one automatic projector of 8,000 and two of 25,000 candle power each. The latter are hand-fed lamps, and are especially built for easy and rapid movements. They are used to follow the glass balls in the shooting act, and the illumination is so perfect that the marksmen prefer the evening to the day performance. These lamps are operated from the "Texas," the distributing booth for all arena and grand-stand illumination, located on the roof of the grand stand and equipped with modern controlling apparatus. The lamps are also used for the especial illumination of groups, racing horsemen, etc. Many strange and beautiful insects fall victims of the bright light from these lamps, and Superintendent Bailey has secured several fine collections, which are being preserved.

The arena is 448 feet in length and 236 feet wide, and contains

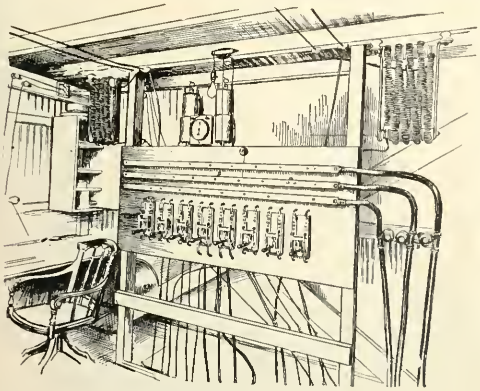


PLAN OF THE POWER-HOUSE.



PLAN OF GROUNDS SHOWING LIGHTING CIRCUITS.

105,728 square feet of ground. It has a network of tile drains, which effectually remove all water during heavy rains and enables the performance to take place regardless of the weather. It is lighted by 46 4,000-c. p. diffusion lamps, 23 on each side, located immediately underneath the edge of the grand-stand shed.

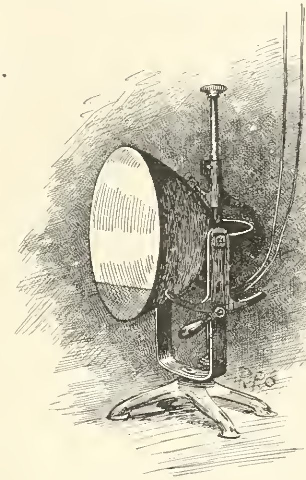


INTERIOR OF THE "TEXAS."

They are 23½ feet above the level of the arena and supported upon suspended platforms, which are reached, through scuttles from the roof. All lamps are fitted with wire screens across their lower half to catch any pieces of carbon that may fall from the arc. They are also controlled from the "Texas," and are so wired that alternate

SHOOTING GLASS BALLS BY THE ELECTRIC LIGHT.

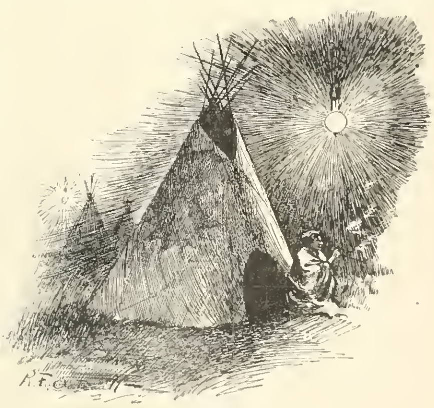
lamps, comprising one-half the circuit, can be thrown in at once. It has been found impracticable to throw into circuit all the arena lamps at one time, as this enormous increase in load is especially disastrous to belts and also severely strains the engines. Two 4,000-c. p. diffusion lamps are trained upon the curtain or scene, which contains 20,456 square feet of canvas. Much trouble and annoyance has resulted in the effort to secure a satisfactory reflector for these diffusion lamps, nearly every reflector tried having shown a very decided shadow of the carbon points. The light next to this shadow would be very white, and surrounding this white spot there would be several rings, each less luminous than the preceding one. The reflector now used, however, gives very excellent results, the diffusion of light being the same at any point in the area lighted from any single lamp. It was designed by Mr. Bailey, superintendent of



HAND-FEED SEARCH LIGHT.

lighting for the "Wild West" organization, and built by I. P. Frink of New York. It is made of copper, and of the form of a somewhat flattened sphere, and its reflecting and diffusion qualities are due to small sections of corrugated glass mirror with which it is lined. The intense heat so quickly destroys the silver upon the glass at the point nearest to the arc, that white opalescent glass is substituted, to cover a small circular space at the centre of the reflector.

It may be interesting to note here that on clear nights the operators of the projectors at Union Square, Buffalo Bill's Wild West and Manhattan Beach, Coney Island, entertain themselves by signalling back and forth. It is said that messages, in the Morse code, have in this way been successfully transmitted between these points.



BEFORE THE LIGHTS GO OUT.

The distance from Manhattan Beach to Union Square is about fourteen miles, the "Wild West" being about midway between the two places.

The grounds are lighted by seventy seven 2,000-c. p. incandescent arcs, while the buildings and tents require over 800 16-c. p. incandescent lamps. The grand-stand, seating 21,000 people, is lighted by 400 16-c. p. incandescent lamps.

Upon the roof of the power-house is a large illuminated sign,

showing the name of the "Edison Company." To produce this it requires 375 16-c. p. incandescent lamps. As one enters the main gate it is brought into prominent view, although at the farthest end of the grounds, and the contrast between the brilliant lamps and the dark sky is very striking.

This plant, which is fully one-third larger than the one used at the World's Fair, is probably the largest isolated plant in existence used exclusively for a single entertainment.

The performance is both instructive and entertaining, and the performers have been selected from no less than twelve different nations. It is, indeed, an organization that can truthfully boast of representing "The Rough Riders of the World."

The Discharge of Magnetism.

BY M. A. AGELASTO.

The following experiments relate to the discharge of magnetic lines of force from a magnetized iron core; the rate of this discharge from the various portions of an iron core; the relation between the rates of the charge and discharge and the air gap

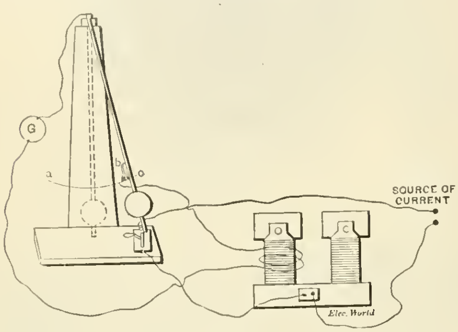


Fig. 1.

of the magnetic circuit, and a new method of studying the various stages of discharge.

In the first three groups of experiments, the ballistic galvanometer method was employed. The number of lines of force which disappear during a short interval of time can be measured by the throw produced by the current induced in a circuit containing the ballistic galvanometer, the circuit being closed during that interval.

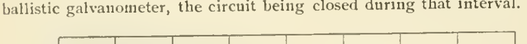
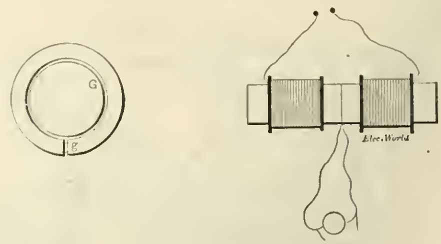


Fig. 2.

Hence, having first measured a deflection produced by the entire discharge, a partial discharge could be measured in the following way: The galvanometer is kept out of circuit for a certain portion of the time of the discharge. The deflection thus obtained subtracted from the deflection produced by the total discharge previously obtained gives a difference which measures the given portion of the discharge which took place while the galvanometer was out of circuit. Fig. 1 illustrates the disposition of the apparatus used, and renders detailed description unnecessary.

The secondary circuit is closed through the arm of the pendulum by means of a flexible brush, b, of fine silver threads connected



Figs. 3 and 4.

to the arm, and making a sliding contact with a stationary brass strip, ac. This strip is divided into distances over which the sliding contact passes in 1-128 part of the whole period of the swing of the pendulum, which was one second.

The ballistic galvanometer (which had a period of ten seconds) could be kept out of circuit during any portion of the swing of the pendulum by the simple means of covering any portion of the brass strip with a sheet of mica. For instance, if a piece of mica is laid on the brass strip so as to cover the distance which the sliding contact passes over in 1-128 of a second, the galvanometer will be out of circuit during that interval of time. By subtracting the deflections thus obtained, when the galvanometer circuit was interrupted during a short interval, from the deflection obtained by the uninterrupted discharge, the discharge during the various definite intervals of time was obtained.

The pendulum, weighing three pounds, had a swing of one second, and was so connected to a key that at the instant when the main circuit was broken the pendulum was set into motion. The electromagnet experimented on is shown in Fig. 1. It consists of two soft iron cores four inches in diameter and ten inches long, energized by two coils of 3,000 turns each. By sliding the pole pieces, any length of air gap could be obtained.

The curves, Fig. 2, give the results of experiments with different air gaps beginning with a closed magnetic circuit. The abscissæ give the time which elapsed between the instant the discharge

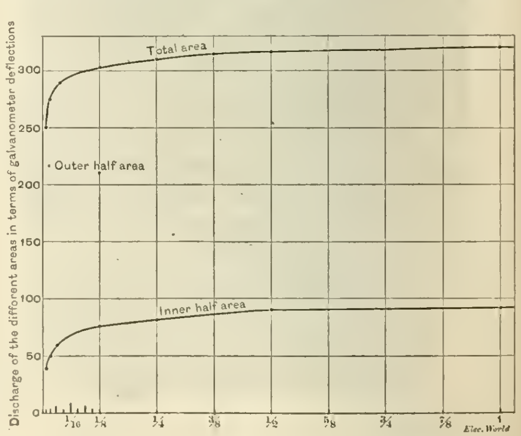


Fig. 5.

began and the moment when the ballistic galvanometer circuit was closed. The ordinates represent the discharges for the different air gaps, during these various intervals of time.

The second group of experiments was to determine how magnetism discharges from the different portions of an iron core and during different intervals of time. There has been considerable speculation on the subject, but little or no experimental results are

available. The method of performing this experiment was suggested to me by Prof. F. B. Crocker, of Columbia College, where all of the experiments were made. The rate of discharge of the inner and of the outer half area of an iron core was obtained in the following way: Two iron cores, each about twelve inches long and two inches in diameter, were placed tightly face to face. In the face of one of the cores, Fig. 3, a small circular groove G was cut at such a distance from the centre that it divided the total cross section into two equal areas. In these grooves a small coil was placed whose terminals were led to the galvanometer through another groove, g, leading to the circular groove.

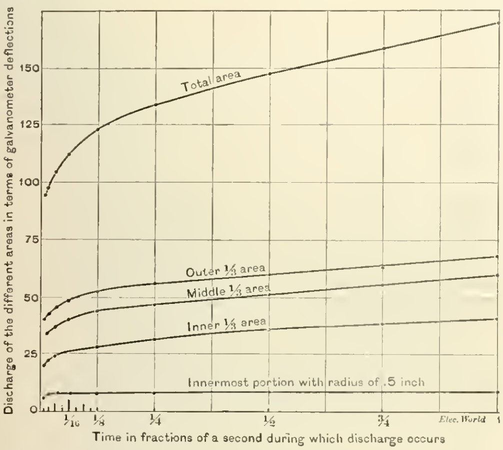


FIG. 6.

The arrangement of the cores, coils and galvanometer is shown in Fig. 4.

The curve, Fig. 5, represents the rate of discharge of the total area and that of the inner half area. The readings were obtained in the same manner as those in Fig. 2. From these curves it is seen that over two-thirds of the total discharge occurs in the outer half area, and almost all of that takes place in the first 1-128 of a second. This probably indicates that the residual magnetism is mostly confined to the centre of the core.

The rate of discharge of the different portions was then determined in the case of the large electromagnet used in the experiments plotted in Fig. 2. The magnetic circuit was so arranged that when

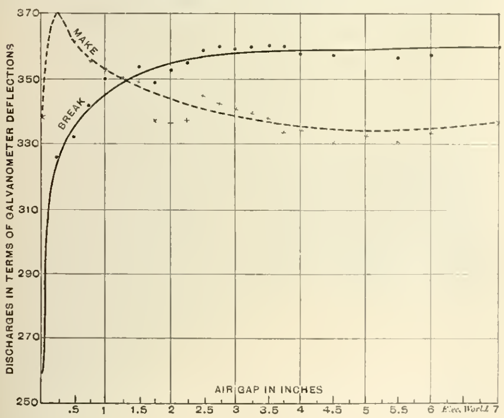


FIG. 7.

closed it contained coils in three circular grooves, two of which grooves were at such a distance from the centre that the total surface area was divided into three equal areas. The third circular groove had a radius of half an inch. The discharges of the total area, of each of the equal areas and of the innermost area are seen in the curves of Fig. 6.

The rate of discharge of an iron pipe and of a bundle of iron wires was next determined. The iron pipe (open circuit), 2.5 inches in diameter, .25 of an inch thick, and 15 inches long, discharged entirely in 1-128 of a second; for, if the galvanometer was kept out of circuit 1-128 of a second no deflection was obtained. The bundle of iron wires discharged within 1-256 of a second. The third group of experiments was to show the relation between the charge and discharge, and the air gap of the magnetic circuit. The curves of Fig. 7 give the average readings of ten observations for each charge and each discharge at different air gaps beginning with a closed magnetic circuit.

It will be seen that the effect of making the electric circuit is much greater than that of breaking it for a closed magnetic circuit; that as soon as an air gap is introduced the break deflection increases until with an air gap of about 1.5 it becomes greater than that of the make; and that gradually increasing the air gap to eight inches does not materially change the deflection obtained for the make and for the break. Increasing the air gap to 12 inches (which was as far as it could be increased) reduced the make effect to 289.8, and the break to 310. It was noticed that the first charge after the magnet had been allowed, as it were, to rest for a day or so, was greater than those which followed, due to the effect of the residual magnetism.

The following is a method employed to study the various stages of discharge.

A brass cylinder, a, Fig. 8, three inches in diameter connected to the axle of a motor and rotated at about 10 revolutions per second is encircled by filter paper (not seen in diagram) saturated with a solution of iodide of potassium and starch. One pole, b, of the secondary coil is joined to the axle of the cylinder, the other pole, c, pressing upon the surface of the paper which encircles the rotating cylinder. In this manner the instant the circuit, d, is broken the induced current completes its circuit through the prepared paper, thereby making a distinct bluish brown line. This method gave results which in the main confirm those obtained by the ballistic method and also suggests actions which could not be detected by the ballistic arrangement employed in the previous experiments. A finely laminated iron ring with a core of four inches in diameter

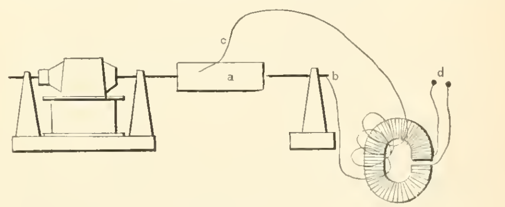


FIG. 8.

wound with 2,000 turns, and with an air gap .75 of an inch, was experimented upon, (a) with magnetizing currents between half an ampere and fifteen amperes, (b) with about the same magnetizing currents as in (a), but instantaneously reversed.

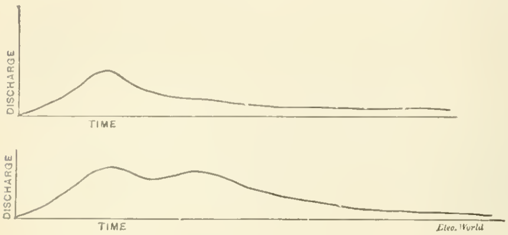
(A) The lines obtained on the rotating sensitive paper with a magnetizing force due to two and to three amperes have the appearance, shown in Fig. 9, of a sudden large discharge occurring in the early part of the total discharge. The discharge after the first large effect gradually weakens and tapers off till it becomes invisible. If a too great number of turns is placed in the secondary, this sudden large discharge is so intense that a spark is produced which causes a layer of gas to be formed between the paper and the contact point, and breaks the circuit, producing a mark having the appearance shown in Fig. 10.

Fig. 11 is a curve plotted with the time as the abscissæ, and the amount of discharge as the ordinates, for magnetizing forces of 2 or of 3 amperes, and with a number of turns in the secondary not sufficient to produce a spark. Experimenting with lower magnetizing force than those before used, the line produced on the sensitive paper is shown in Fig. 12, the discharge resuming its intensity after the first sudden large discharge has begun to weaken. Of course, this irregularity may be due to some other cause than magnetic oscillations, but there is every reason to believe, judging from the precautions taken to, eliminate every possible error, that it is due to the fact that the discharge of magnetism is oscillatory, in certain cases at least. With large magnetizing forces this does not appear.

A curve plotted with the time as the abscissæ and amount of

discharge as the ordinate would have the appearance of Fig. 13. When the magnetizing force is increased the sudden large discharge occurs in the latter part of the total discharge. For instance, the line traced on the sensitive paper with a magnetizing force of 6 amperes, 2,000 turns, is like that in Fig. 14, and the line with a magnetizing force of 15 amperes, 2,000 turns, has the appearance shown in Fig. 15.

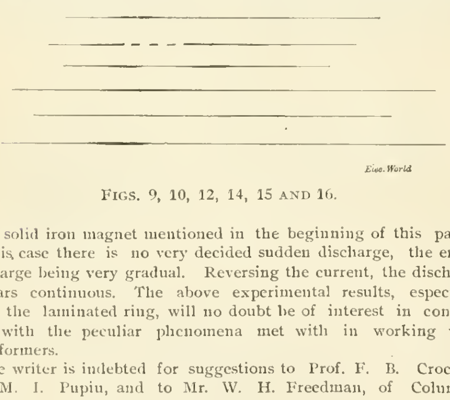
(b) The discharge by instantly reversing the magnetizing force of two and of three amperes produced the line on the sensitive paper,



FIGS. 11 AND 13.

represented in Fig. 16, showing that as soon as the almost instantaneous reversal of the current occurs there is a second large sudden discharge. After this second large discharge, although the magnet used was finely laminated, the discharge was very slow. Using higher magnetizing forces, the reversal of the current was not so apparent as when low magnetizations were used.

A closed ring with an endless curve of fine iron wire as would be expected showed scarcely any discharge, although high magnetizing forces were used. When only half the ring was magnetized, thus causing breakage, the results were the same as for the laminated ring with an air gap. The last experiments were made with the



FIGS. 9, 10, 12, 14, 15 AND 16.

large solid iron magnet mentioned in the beginning of this paper. In this case there is no very decided sudden discharge, the entire discharge being very gradual. Reversing the current, the discharge appears continuous. The above experimental results, especially with the laminated ring, will no doubt be of interest in connection with the peculiar phenomena met with in working with transformers.

The writer is indebted for suggestions to Prof. F. B. Crocker, Dr. M. I. Pupin, and to Mr. W. H. Freedman, of Columbia College.

Tesla Currents with Simple Apparatus.

Mr. F. Himstedt publishes in Wiedemann's Annalen, vol. 52, page 473, some interesting researches with Tesla currents, produced by means of rather simple apparatus. We give below a translation of an abstract of this paper as published in the Elektrotechnische Zeitschrift, July 12.

The reason why the researches of Tesla have not been reproduced in Germany is probably due to the fact that the apparatus which he used was not at hand. It is very interesting to note that the author succeeded in reproducing most of the results with exceedingly simple apparatus. He at first used Lecher's arrangement for the production of Hertzian waves, but afterward used still better known apparatus, namely, Leyden jars.

He connected the pole of a powerful Ruhmkorff coil (50 cm. long and 20 cm. diameter, using from 5 to 6 accumulators) with the inner coatings of two moderately large Leyden jars, insulated from each other by being placed on paraffine; he also used a spark micrometer. The outer coatings of the jars were connected with a 4 mm. wire, 150 cm. long and bent in the shape of a U. A 16-volt incandescent lamp connected in parallel to this wire was brought to a white heat by proper adjustment of the micrometer. By using jars 16 cm. in diameter and 42 cm. high, three lamps could be made to glow, hung over each other, one a 65-volt lamp at the bottom, then a 16-volt lamp in the middle and a 2-volt lamp at the top.

If the middle of the glass bulb of such a lamp is filed off it will either not glow or glow very little. Tesla explains this by the different bombardment of the molecules of the glass in the bulb, while the author ascribes the result to the different heat conducting power of the air which entered.

If the incandescent body is a platinum wire of 0.05 to 0.1 mm. diameter, it will oscillate rapidly while glowing, taking the form of a zigzag line, not in a single plane like a stretched string, but in all possible planes, thus representing a model of a ray of natural light. A condition for the success of the experiments is the use of an interrupter which operates with certainty, as also in the use of a proper spark micrometer. He recommends the Foucault interrupter with tough zinc amalgam instead of mercury, covered with machine oil. The spheres of the micrometer are best made of zinc.

A Tesla transformer was constructed as follows: On a glass cylinder of 4 cm. diameter he wound 10 turns of a 4 mm. wire, with a distance between the windings of 1 cm., over which a thick glass cylinder, or better, a hard rubber cylinder of 6 mm. thickness, was placed, and on it were wound 200 windings of a 1 mm. wire. In order that the distance between the windings may be made 1 mm. two similar wires were wound next to each other, after which one of them was again unwound. The transformer was placed horizontally in an earthenware vessel filled with machine oil, and supported on hard rubber, and the secondary winding ended in two metallic balls on hard rubber pillars. The primary winding was connected with the Leyden jars in place of the above mentioned U form wire. When the interrupter is in action, brush discharges will appear at the knobs; if a conductor is placed near them, bright sparks will pass to it. Between two parallel wires connected to these knobs, a bright band of light of three to four metres in length will be formed.

If one pole is connected to earth and the other to a thin wire 15 to 20 cm. long which hangs freely suspended, it will begin to move and describe a cone-shaped figure which is distinctly visible in the dark on account of the brush discharges which take place from it.

If a person takes hold of one pole of such a coil, bundles of rays can be drawn out from any part of his body near which a conductor is approached. If the person is standing on a metallic plate a prickling sensation will be produced in the feet; in the dark, discharges will be seen to pass out of the shoes. If several persons are connected together the first taking hold of one pole of the transformer, while the last holds a Geissler tube with or without electrodes, this tube will be brightly illuminated, although none of the persons will feel the discharges.

If one pole is connected to earth and the other to a large metal sphere, 60 cm. in diameter, Geissler tubes will be brightly illuminated at distances of from three to four metres from this sphere.

An incandescent lamp connected with the pole which is not connected to earth shows only the pale light of a Geissler tube. But if a large metallic disc is connected to the glass bulb, the lamp will glow brightly. The filament will, in that case, oscillate so that it soon breaks. If a conductor be approached to the point of the lamp this point will be immediately pierced by the current and a continual bright stream of sparks will pass through the opening, and the filament will at once begin to glow until it is consumed.

In the second part of his paper the author states that a Tesla coil is quite different in its actions from an ordinary induction coil. A Geissler tube connected in any way with the pole of a Tesla coil shows cathode light at both electrodes, an anode light in the middle. A commutation of the primary current or a reversal of the pole has no effect. An electroscope is always charged positively when it is approached with a pole terminating in a point. Both poles produce only positive Lichtenberg figures, never negative.

Researches with different gases show that this preponderance of the positive discharges from the pole of a Tesla coil depends on the surrounding medium. Air or oxygen promote positive discharges; hydrogen, illuminating gas, nitrogen, carbonic acid gas and ammonia, promote negative discharges.

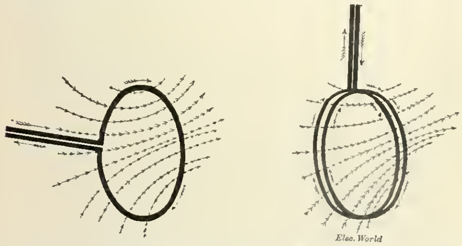
If two points are connected with one pole, one in air and the other in hydrogen, positive and negative electricity will be discharged simultaneously from the same pole, depending on the surrounding gas. If one of the points is in oxygen, and if gradually more and more nitrogen is added, an electroscope opposite the point will at first show a moderate positive charge; with increasing quantities of nitrogen this will increase; when the mixture corresponds to that of air the positive charge will reach a maximum; if the nitrogen is

in excess the charge will be reversed and will become negative. The process is similar if it is begun with nitrogen and the oxygen gradually added. With an ordinary induction coil the charge of an electroscope will be reversed when the primary current is reversed.

Dynamo-Electric Machinery—VII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

36. The physical mechanism of the magnetic flux produced by a current is unknown, but if an electric current be assumed to be due to a vortex of ether in the wire, the direction of which is dependent on the direction of the current through the wire, then such vortex motion will be accompanied by a distribution of circular stream-lines in the ether, such as is actually manifested, and when the direction of the current through the conductor is changed, the direction of the stream-lines outside the conductor will necessarily be changed. As the strength of the current through the wire increases, the velocity of the

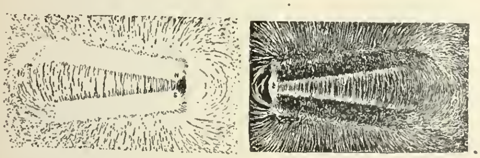


FIGS. 29 AND 30.—SINGLE LOOP OF ACTIVE CONDUCTOR, THREADED WITH FLUX, AND DOUBLE LOOP WITH M. M. F. DOUBLED.

ether surrounding the wire increases; i. e., the intensity of the magnetic field everywhere increases.

37. If a conductor conveying a current be bent in the form of a circle as shown in Fig. 29, and a current, of, say, one ampere, be sent through the conductor, then there passes through the loop so formed a certain number and intensity of stream-lines as represented. If now, the current in the wire be increased to two amperes, the flux intensity everywhere will be doubled. The same effect, however, can be practically obtained by sending one ampere through the double loop, shown in Fig. 30, provided the two turns are very close together. Magnetic flux through a loop, will depend, therefore, upon the number of ampere turns, and by winding the loop in a coil of many turns, the flux produced by a single ampere through the coil may be very great. The M. M. F. produced by a current, therefore, depends upon the number of ampere-turns.

38. The unit of M. M. F. may be taken as the ampere-turn, and it frequently is so taken for purposes of convenience. The fundamental unit, however, of M. M. F. is the gilbert, named after one of the earliest magneticians, Dr. Gilbert, of Colchester. The gilbert is produced by $\frac{1}{4\pi}$ of a C. G. S. unit current-turn, and, since the C. G. S. unit of cur-

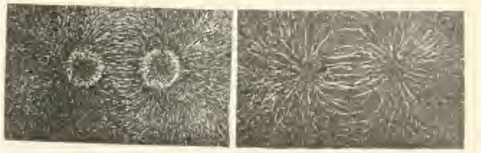


FIGS. 31 AND 32.—DISTRIBUTION OF FLUX IN PLANE OVER A HORSESHOE MAGNET.

rent is ten amperes, the gilbert is produced by $\frac{10}{4\pi}$ ampere-turn (0.8 approximately, more nearly 0.7958). It is only necessary, therefore, to divide the number of ampere-turns in any coil of wire by 1.8, that is to multiply the number of ampere-turns by 1.25 (more nearly 1.257) to obtain the M. M. F. of that coil expressed in gilberts.

39. Figs. 31 to 42 are taken from actual flux distributions as obtained by iron filings, and represent a series of negatives or positives secured by the means already described. A study of such flux-paths enables the student to mentally picture the flux distributions that occur in practice.

Figs. 31 and 32 are the respective positive and negative taken in the case of a horse-shoe magnet. Here outside the magnet the filings are absent in a region in the neighborhood of the poles NS. The cause of this is as follows: The fields were obtained by sprinkling iron filings over a smooth glass surface; the tapping of the sur-



FIGS. 33 AND 34.—DISTRIBUTION OF FLUX BY IRON FILING AND BY CUT IRON WIRES IN PLANE OVER POLES OF ELECTRO MAGNET.

face necessary to insure the arrangement of the filings under the influence of the magnetic flux has caused an accumulation of filings around these poles at the expense of the gap immediately in front of the poles which would otherwise be more fairly filled.

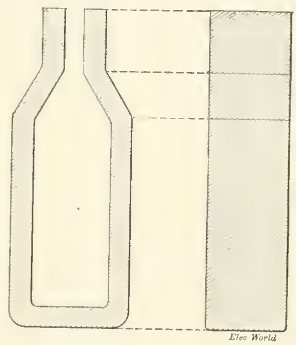
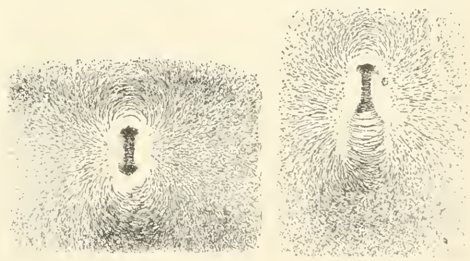


FIG. 35.—PLAN AND SIDE ELEVATION OF MAGNET EMPLOYED IN CONNECTION WITH FIGS. 36 AND 37.

Furthermore the student must not be misled by the supposition that the relative attractive tendencies of the iron filings represent the corresponding densities of magnetic flux, for the reason that in a uniform magnetic flux such as shown at A, in Fig. 25, whatever its intensity, there is no attraction of iron filings, and consequently variations of flux intensity always exaggerate the appearance of flux density as indicated by iron filings. Generally



FIGS. 36 AND 37.—DISTRIBUTION OF FLUX BY IRON FILINGS IN PLANES OVER MAGNET SHOWN IN FIG. 35.

speaking, therefore, it is only the direction assumed by the filings, as indicative of the direction of the flux, which can be regarded as trustworthy.

Fig. 33 shows the distribution of magnetic flux as obtained by iron filings in a horizontal plane over the vertical poles of an electro-magnet. Here the flux-paths pass in straight lines between the nearest points of the adjacent poles, and in curved lines over all other parts of the plane. If we imagine, following the hydraulic analogue, that water streams proceed from minute apertures in one of the poles, and that the magnet be immersed in water, then the stream-lines so produced in the water as it emerges from pole N,

and enters through pole S, will be the same as indicated by the iron filings. Fig. 34 shows a similar distribution of flux over the poles of the same electro-magnet, using short pieces of fine soft iron wire in place of the iron filings. Here the flux-paths have practically the same distribution as in the preceding case.

Figs. 36 and 37 show the distribution of flux by iron filings in a horizontal plane over the poles of the magnet represented in Fig 35, the magnet being presented vertically, and in Fig. 37 horizontally, to the plane. Here the general distribution of flux between the polar surfaces is rectilinear.

(To be continued.)

Electric Lighting at Zurich, Switzerland.

An elaborate report by Mr. Wyssling, Electrical Engineer to the municipality of Zurich, has just been issued for the year 1893, and contains much information of general interest to all engaged in the electric supply business. It is the first report issued relative to this undertaking, as the municipal authorities only took over the plant in the early stages of its erection, about the middle of 1892.

The Electrical World of June 2 and 9, 1894, contained an illustrated description of this plant, wherein Mr. Fred Bathurst pointed out that with its 10,000 lamps (7,600 actually connected) it was the largest existent example of a high pressure alternating current being distributed from a number of isolated and independent sub-centres of secondary distribution.

This plan, in a town like Zurich, with 100,000 inhabitants, where the chief business interests do not centre in one location, offers the advantage of a simplified system of conductors and satisfactory service to all districts requiring current.

The report is divided into two parts, one dealing with the cost of erection and the development of the business, and the other with the working conditions and the cost of supply.

Owing to the fact that the motor power is derived from turbines which serve also for the municipal water supply and cannot therefore be charged up as belonging entirely to the electric lighting plant, the prime cost account shows exactly what the electrical apparatus has cost by itself. This figures out at $19.40 per lamp installed, and is itemized as follows:

Four dollars and eighty cents per lamp for generating machinery, inclusive of exciter, switchboard, etc., in fact everything after the transmission shafting; $5.40 per lamp for the network of primary feeders; $7.20 per lamp for the network of secondary or low tension distributing mains; $1.60 per lamp for the converters, including their hangings; 40 cents per lamp for meters.

It will be noted that the cost of converters is, and as would be expected from this system, very low, whilst the feeding cables and distributing mains—that is, the means of distribution—have cost nearly twice as much as the machines for generating.

When making comparison with the American system of a converter for each house connected, consideration must be given to the fact that all the wiring is underground and effects a permanent economy in the cost of maintenance and the risk of interruption.

The cost of the cable laying is again itemized, and it is shown that there are in the town 22.2 kilometres, or 13.78 miles of conduit, which involved an expenditure of $1.72 per yard. Of this 40 cents per yard is the cost of the earthenware conduit and $1.32 per yard the cost of opening up and reclosing the trench that received it; or in other words, the cost of laying was three times the cost of the conduit itself.

Testimony as to the excellence and thoroughness of the construction of the entire installation is found in the fact that of the total investment of $190,000 it is considered that a 5 per cent. allowance easily covers the yearly depreciation.

The above figures are calculated upon 8,500 lamps, but the estimated amounts required to complete the installation bring the ultimate total to such a sum that they may be accepted as holding good for a 10,000 lamp installation.

This second part of the report shows very clearly the drawbacks which every electric lighting station has to contend with in variations of the demand upon it.

The business policy of the municipality has been to obtain mainly those consumers who would burn lights continuously and regularly, by fixing a certain minimum charge per year for every lamp connected, but even with this condition the curves show that the average daily maximum is twenty times greater than the average daily minimum load. The policy shows best in the annual distribution of load, for the average daily output for the Summer months is as much as one-third that of the Winter months. The average number of lamps per connection is nineteen. It is shown that 74 per cent. of the total number of lamps connected may be taken as the maximum number that will be alight at the same time.

Very careful records have been kept of the output of the station throughout every day of the year, and taking these in these with the records of power delivered from the turbines and the number of lamps burning, extensive tables are made up to show the actual efficiency of the plant under all conditions.

These tables point out how in the Summer months (June) with light loads the efficiency is perhaps as low as 28 to 30 per cent., but in Winter (December) with the greater average load it improved to 57 or 58 per cent., and when averaged up for all the year round comes out at 45 per cent. That is out of every 100 h. p. of mechanical energy put into the shafting and transmission gearing in the central station the municipality receives an income upon 45 h. p. appearing as electrical energy.

The loss varies in the different apparatus with the load, but is approximately 20 per cent. in the transformers, 17 per cent. in the network of distribution, 20 per cent. in the alternating generators, and 7 per cent. in the excitation of the generators.

Every station management is incited to get a more equable and constant load when it is here shown by Mr. Wyssling's calculations that it would be possible, with the ideal conditions of an evenly distributed output, to supply this town with its yearly supply of watt-hours with a plant only one-eighth the size of the present installation.

The report concludes by stating that the system adopted has proved very practical and pleasing, both to the management and the consumer; the greatest advantages arise through the simplicity and construction of the distributing network and the immunity from any trouble from high potential primary wires.

He suggests that it may be necessary to increase the number of distributing sub-stations (at present there are eight), so as to provide for the increasing demand of the other growing districts. Some, he says, might be advantageously and economically dealt with by being provided with accumulators, and predicts that this solution may soon become possible because of the improvements that are being effected in motors suitable for transforming alternating into continuous currents or other devices for commutating alternating into direct currents.

A Model English Isolated Plant.

One of the recent important improvements made by the Duke of Norfolk at Arundel Castle is the installation of an electric lighting plant which embodies some novel features and all the modern improvements. Some four years ago Mr. Gisbert Kapp was consulted in regard to lighting the castle and reported that about 1,200 16-c. p. lamps would be required, and recommended the use of a continuous current low tension system. Various English contractors were requested to offer plans for interior lighting and the contract was finally awarded to the Brush Electrical Engineering Company, who supplied and installed the entire machinery and plant.

The lighting station itself is a pleasing bit of architecture of what may be called the Elizabethan domestic style, half villa and half power-house. The woodwork of the exterior is old English oak and the brick work of a dull red color, while the interior, which is divided into four rooms, is finished in greenish grey glazed brick. The dimensions of the building are 92x48 feet and its height 36 feet. The boiler house, 45x31 feet, contains three Galloway steel boilers 18 feet long and 6½ feet in diameter, with two flues, and having a capacity each of 3,300 pounds of water per hour.

In the engine-house, which is 36x24 feet, are three 90 h. p. vertical inverted compound double action engines of the Brush-Falcon type, with cylinders 12″x20″ and 14 inch stroke. To each of these a specially compounded self-regulating dynamo is direct connected, the dynamos being mounted on the continuation of the engine bed plate. The dynamos have in addition to the ordinary compounding an extra compound winding in series with the main circuits, thus compensating for the loss in the main whether one machine is running alone or two in parallel. The machines are of the multipolar type, each having eight poles, with drum armatures and supplied with Kapp segmental connectors. When used as a simple shunt machine for charging accumulators at a speed of 140 revolutions the capacity of each dynamo is 64 kw. at 160 volts, and when used as a compound dynamo for supplying the lamps direct and running at 120 revolutions the capacity is 51.2 kw. at 128 volts. The machines are compounded to give the required pressure at the switchboard in the castle with a variation of not more than two volts between full load and no load. The engines are fitted with Raworth patent expansion governors adjustable by hand while running from about 120 to 140 revolutions, so as to enable the same

machine to run compound direct on the lights or as a simple shunt machine to charge the cells.

The main switchboard is on the wall facing the engines and contains switches for working two or three dynamos in parallel or singly, together with the necessary measuring and indicating instruments. Below the main switches are rheostats for controlling the fields of the dynamos when running as simple shunt machines for charging the cells, and these rheostats are connected with links to the main switches so that if the main switch were accidentally changed over from charging to lighting the whole resistance of the rheostats would be inserted and the danger of throwing the high charging voltage into the lamps would be avoided.

In the accumulator room, which is 31x18 feet, there are two sets of storage batteries consisting of 62 cells of the D. P. type manufactured by Messrs. Johnson & Phillips, and capable of feeding 260 16-c. p. lamps for 10 hours or 440 for 5½ hours. The batteries are charged in sets in parallel, regulating rheostats being in the charging circuit of each set. None of the lighting cells are ever cut out of circuit, their E. M. F. being controlled by inserting a greater or less number of opposition E. M. F. cells composed of plain lead grids, which, as the current always passes through them in one direction only, are always well formed and ready to give an opposing E. M. F. when required.

The distributing room is situated in the old dungeon tower of the castle and is about 1,300 feet from the generating station. The feeders consist of two pairs of cables, each having a sectional area of about .8 per square inch. The two cables in the dungeon are brought up to the distributing board and connected by plug switches, by means of which, in connection with a similar arrangement at the generating station end, the cables can be readily interchanged. A ring main is laid from the distributing main around the castle court yard, its length being about 800 feet. It has a sectional area of about the same as one of the cables. This is tapped at five different points and branches run to the service switchboards in the corridors within the castle. From the distributing room two pairs of cables are taken for the purpose of supplying the outside lamps and the lamps in the lodge.

From the generating station a pilot wire is laid in the main cable, and in addition to this a separate cable, consisting of three conductors for the purpose of indicating pressure, or signaling, is also provided. The main cable, which consists of sixty wires, is sheathed by a heavy tube of lead and protected by yarn dressed with a preservative compound and laid directly in the ground, planks being laid over it to protect it from all possible injury.

The inside wiring is all done with circuit distributing boards in which the fuses are grouped, not more than seven lamps being on one fuse and in most cases a less number. According to a test, the maximum drop from the ring main to the farthest light is 1.8 volts.

The details of the interior fittings have not yet been decided upon, as experiments are being carried on in order to obtain the most artistic and satisfactory means of lighting the castle.

Laboratory Notes—XX.

BY LIEUT. F. JARVIS PATTEN.

APPARATUS FOR GENERATING ALTERNATING CURRENTS OF ANY FREQUENCY.

A description of simple apparatus for generating an alternating current of any desired frequency will doubtless be found useful for laboratory workers. The term "any frequency" of course means within the practical limits of ordinary motor speeds which may easily yield two hundred periods a second, but the method used is exceedingly well adapted to give very low frequencies with great exactness and though such frequencies have no place in applied electricity to-day, they are sometimes useful in experimental work.

The plan in general terms is to cause an exciting field to rotate one way while the generating armature is turning in the opposite direction. If the speeds of the two are alike and the maximum obtainable from the driving motor, the generating armature would give a frequency double that obtainable from the same armature moving in a fixed field.

It is plain, however, that this is not the maximum frequency that can be obtained from such a device under a given limit of speed of say 2,400 a minute.

Thus we may give the field a ring form, which indeed would be preferable as it is designed to revolve it also; then we can excite the field by two alternating currents in quadrature, generated we will say by an independent armature that gives a frequency corresponding to the speed of the revolving field, which is the simplest case. Then if the field ring of what we will consider the single alternating current generator (or variable frequency generator) were clamped the biphase field currents would produce a revolving field that would turn, say contra-clockwise, at the speed of the driving motor 2,400 a minute, this, however, with respect to the fixed points of the ring winding where the biphase currents are introduced. If now the ring itself is mechanically driven also contra-clockwise at the same rate, the field poles of the ring would turn in space at a rate of 4,800 a minute.

If now the armature within this revolving field, say for convenience a simple two-pole armature, be driven in the opposite direction (clockwise) mechanically by the same motor, it would then give a single alternating current due to a speed of 7,200 revolutions a minute if driven in a fixed field excited by a direct current.

Thus we would have a frequency of 120 a second, an ordinary commercial speed from a two-pole armature in a ring field.

With slight modifications of the apparatus any frequency can be obtained from this maximum down to very near zero, and the means required for obtaining the different rates are not so complex as would seem. This arises from the fact that the direction of rotation of the field created by the biphase currents can be reversed by simply reversing the connections to the ring of one of the biphase currents. Thus, if we suppose the ring itself turning then by one system of connecting the biphase currents, the revolving field will be turning the same way as the ring itself, thus producing a double or maximum possible speed of the field in space or with reference to the armature. By changing the connections of one biphase current the field would be turning oppositely to the ring and the field poles if the two speeds were alike (the assumption hertofore made) would then remain fixed in space, producing the same effect as if the ring were excited by direct current introduced at the extremities of a fixed diameter of the winding, in which case the freqency would be determined by the speed of the armature alone as if it had a fixed direct current field. Thus with only a single fixed speed of say 2,400 that can be applied to either or both parts in either direction we have three possible combinations namely:

With fixed ring, biphase revolving field and fixed armature, we get 40 periods a second.

With fixed ring, revolving field and armature turning in opposite direction we get 80 periods a second.

With ring turning same way as field and the armature in opposite direction we get 120 periods a second.

The other possible combinations with only one speed always give one of the above results.

To get frequencies intermediate between these or very low frequencies it is necessary to provide means for driving one of the parts, preferably the armature, at a variable speed.

Thus the ring field and armature of the biphase generator for supplying the field currents should be both driven by the spindle of a constant speed direct current motor turning at say 2,400 a minute, and let the armature be carried by the spindle of another direct current motor arranged on the Ward-Leonard system or any convenient plan by which its speed can be gradually slowed down from the maximum (2,400) to near zero; we shall then be able to get from this apparatus any frequency between 90 and 120 periods a second.

For instance, if the biphase revolving field turn one way in the fixed ring at 2,400 and the armature driven by the variable speed motor in the same direction be slowed down to 2,340 a minute, the armature will pass the field poles at the rate of 60 a minute, giving a frequency of 1 a second; slowing down the armature to 1,800 would give a frequency of 10 a second, and slowing it to 1,200 would give a period of 20. Finally when the armature is stopped altogether we get a period of 40 a second due to the revolving field alone.

We then reverse the connections of one of the biphase currents which causes the revolving field to turn in a direction opposite to the armature motion, which by the way need never be reversed, and now gradually increasing the armature speed from zero up to its maximum we pass by degrees as slow as we wish from 40 periods a second to 80. The armature is then stopped and the ring is set in motion by its motor at 2,400 in the same direction the field was last revolving, and by again starting the armature up and slowly passing to the maximum speed as before, we pass by degrees from a frequency of 80 to 120 a second.

A Well-devised System of Taxation.

In granting the right for the construction of an electric railway in a town near Berlin, the municipality requires that a fine of $500 be paid to the city if there is any interruption in the running of the cars for which there is not a sufficiently good reason.

How to Make a Dynamo Excite Itself.

BY GEORGE T. HANCHETT.

Of all the minor difficulties which arise in electrical engineering, there is none so annoying as the refusal of a machine to excite itself, or, as it is technically termed, "build."

It often happens when the stockholders and parties interested have assembled to see the new machine start, and it invariably occurs if the district manager has been so injudicious as to invite gentlemen to whom he hopes to sell a machine, or has arranged to have the daughter of the president of the company throw the switch for the first time.

In view of these facts, the writer has collected various data on making a dynamo build, and adding some of his own ideas, has embodied the result in the following article, which he hopes may prove useful.

SERIES MACHINES.

A series dynamo will refuse to excite from any one of the following causes:

(a.) Open circuit, a poor contact.
(b.) Short circuit, field magnets or armature.
(c.) Bobbins so put on as to be opposed to each other.
(d.) Incorrect connections.
(e.) Insufficient residual magnetism.

Inasmuch as it is more or less trouble to test out and correct these difficulties, it is wise to examine the symptoms carefully and make a thoughtful decision as to the nature of the trouble before applying the test and remedy.

(a.) Insufficient contact and open circuit: This difficulty has often proved very elusive. It is to be carefully noted, that a magneto bell is not a decisive test in such a case as this. The

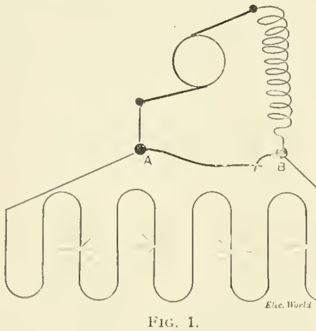


FIG. 1.

initial magnetism of a new machine is apt to be very low, and the resulting voltage correspondingly so, perhaps, one half a volt, or even lower. A magneto bell will ring quite briskly in circuit with a contact through which an electromotive force of one-half a volt would be unable to establish a current sufficient to start the machine. Therefore be absolutely sure of the contacts by carefully inspecting them all. A loose screw or nut or a little lacquer under a contact may be responsible. This is a common difficulty with platers and machines of low voltage, but it sometimes occurs even on arc machines rated at two or three thousand volts. Having made sure that the internal circuit is as it should be, obtain a good external circuit by short circuiting the machine. This must be done very cautiously. It is wise to have the regular load in circuit, and establish the short circuit, as shown in Fig. 1. A good method is to place a short piece of scrap wire in one binding post, and then with a suitable piece of insulating wire make contact between the other binding post and the short piece of wire. Should the machine build it will be at once evident by the sparking of the brushes. The short circuit should then be removed and broken first where the two wires touch. The resulting arc will only burn the wire, and the binding posts of the machine will be uninjured. It is to be remembered that when a series machine is induced to build in this manner that it builds with a rush. It is, therefore, absolutely necessary to be able to instantly remove the short circuit on the appearance of sparks at the commutator. Oftentimes a mere flying touch of the two wires is sufficient, and this should always be tried at first before a firm short circuit is made.

(b.) Short circuited field magnets or armature: It is evident that either of these difficulties deprive the field coils of any energy that may be generated, and so prevent the machine from building. Some series dynamos have a resistance in multiple with the field coils, and thus divert a portion of the current therefrom. When making a refractory series machine build, all resistances and controlling devices connected in this manner should be temporarily cut out by opening the derived circuit. Some series machines have a switch which short circuits the field or armature. Be sure this is open. This seems a useless caution, but the writer has known of cases where it was not done, and considerable valuable time wasted looking for the difficulty elsewhere. Look for the simple things first.

(c.) Bobbins or windings in opposition: This defect rarely occurs unless the machine is assembled, and the bobbins connected when installed. To a man acquainted with the machine such a defect should be obvious at once. It may be discovered also by disconnecting and separately exciting each bobbin with a few cells of battery or other source of current. The resulting poles may be detected with a pocket compass. This will give sufficient information about the direction of the windings to properly connect them.

(d.) Incorrect connections: It often happens that the loose cables and smaller parts of a dynamo are boxed separately. When the machine is installed, if these cables are put on by an inexperienced man they are almost sure to be put on incorrectly. A sketch of the connection should be, and is in most cases, sent with the machine, but even with this aid the inexperienced man is liable to go astray. Therefore look carefully to the connections of the machine.

(e.) Insufficient residual magnetism: This is usually the first cause to which the refusal toexciteis ascribed, but it is scarcely ever necessary to excite temporarily from an outside source. A series machine heavily short circuited will build on a very weak residual magnetism. If, however, it is absolutely necessary to excite the field separately to obtain an initial magnetism the exciting current should be kept on for some time. It will also be well to pound the pole pieces quite heavily with a copper hammer while the magnetizing process is going on. This tends to more thoroughly saturate the magnets.

SHUNT MACHINES.

A shunt machine will refuse to self-excite from any one of the following causes:

(a.) A short circuit or a heavy load.
(b.) An open shunt circuit.
(c.) Bobbins or windings in opposition.
(d.) Incorrect connections.
(e.) Insufficient residual magnetism.

(a.) A short circuit or a heavy load. A shunt machine will not build under these conditions for the reason that a very small fraction of the current generated goes to excite the machine. When the machine starts this initial current is very feeble, and if so small percentage of this already weak current is used in excitation, the chances are that it will not be sufficient to start the dynamo. Therefore in such a case see that the main circuit is open in order that all the current generated may assist in building the voltage.

(b.) An open shunt circuit: It is obvious that if the shunt circuit is open the machine will not build. Such a defect may often be located in the rheostat when a burned out coil or a poorly made connection may be the cause of the difficulty. It may often be detected by short circuiting the rheostat. Sometimes the defect exists on the connections of the machine itself. Often the fault is in the rheostat wires running to the switchboard. The insulation of a wire will sometimes hold the two ends of a broken wire together so as to defy anything but the most careful scrutiny. Nothing but rigid inspection and testing of the entire shunt circuit will locate the difficulty.

(c.) and (d.) These have been discussed under series machines and the same remarks apply.

(e.) Insufficient residual magnetism: In this case the expedient of short circuiting the machine will only make matters worse. If it is possible to obtain a powerful outside source of current the fields may be separately excited, and the pole pieces hammered as described under series machines. If such a current is not available the following device may be used with advantage:

In Fig. 2 let B represent a few cells of Leclanche or Grenet battery; three or four will answer. Let D represent the dynamo and F the shunt field. C is a knife plunge contact and X a fixed point. W is a weight tending to turn the switch S on its pivot A and make contact at C. It is prevented from doing this by a piece of ten ampere fuse, XY, which supports the switch. The battery is connected as shown in such a way that its electromotive force will

assist whatever feeble electromotive force the dynamo may have. The dynamo starts and the combined electromotive forces send sufficient current into the field to build the machine. The voltage of the machine rises and the current in the shunt increases. The ten ampere fuse being under tension fails at about eight amperes. The weight instantly closes the broken shunt circuit and the batteries are thus automatically cut out before they are damaged by excessive current. A machine with eight amperes in its shunt circuit can continue to build without difficulty. At the time of cutting out the batteries their electromotive force will be a very small fraction

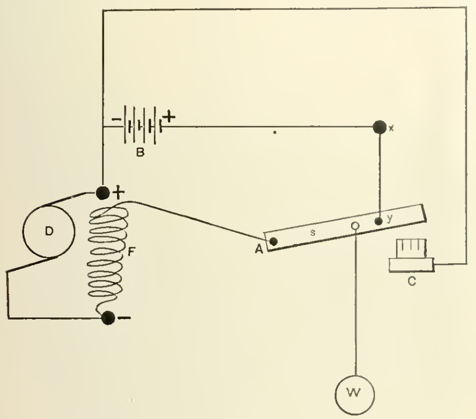


FIG. 2.

of the total, and the resultant current will be very little reduced thereby. It is important that the switch be just barely held open by the fuse wire so that the shunt circuit may be closed before the field magnets have time to discharge. The parts of the device are so simple that it is possible to construct it or its equivalent with almost any material at hand.

Some shunt machines require less than eight amperes for excitation. In such a case after the machine is built the fuse wires XY may be cut with a pair of pliers and the batteries thus cut out and saved from further waste. It is not always known just how much current the shunt circuit of a machine requires, but a momentary current of eight amperes will not injure the ordinary battery. This method may also be used on compound and series machines, but it is hardly ever necessary.

The writer has in the course of his experience encountered several cases where the men in charge did not give the machine time to build.

Shunt and compound machines build very slowly, and especially so when first installed. In some rather exceptional cases it will take five or six minutes to bring the machine to voltage. A man in a hurry and somewhat excited in his desire to have things working properly is liable to try the machine correctly connected, and on its failing to give at once voltage sufficient to light the pilot lamps, he decides that his connections are incorrect, and shutting down proceeds to change them, and thus incurs a long series of failures which a little patience might have avoided.

COMPOUND MACHINES.

These partake of the difficulties of both series and shunt machines, but they also have some that are peculiarly their own. A compound machine will refuse to build when:

(a.) The shunt circuit is open.
(b.) The brushes are heavily short circuited.
(c.) Bobbins are wound in opposition.
(d.) Incorrect connections.
(e.) Insufficient residual magnetism.

(a.) An open shunt circuit. The machine may in this case build if a piece of light (No. 18 or 20) B. & S. copper wire be placed across the terminals. This will burn out, but still the machine will not come up its rated voltage. This shows that the series coil is all right but that the shunt circuit is open. Find and close this open place, and then make a quick short circuit of the dynamo as explained under series machines. In this case, however, it is not well to have the load thrown on. In case the series coil is so connected that it "builds down" the dynamo this method will only tend to destroy what little residual magnetism there is. If, therefore, the machine refuses to build under this treatment cross the series terminals and try again. If the dynamo still refuses to build with its field coils all assisting each other and producing the correct polarity, look for faults (b) and (e) and apply the corresponding remedies.

(b.) A heavy short circuit at the brushes. This should be readily discovered and easily removed.

(c.) This has been discussed under series machines.

(d.) This also has been discussed under series machines, but in addition it is well to note that a compound machine has numerous studs and binding posts and the difficulty is still more liable to occur.

(e.) Insufficient residual magnetism: This may be overome in several ways. The magnets may be remagnetized through the shunt coils by an independent circuit, or the battery method explained on shunt machines may be used. Another very good method is to disconnect the series coils altogether, and separately excite them by a few cells of battery in such a way as to help the shunt coil. A storage battery is admirable for this purpose.

It sometimes happens that the machine will build properly but that its series coils tends to reverse the polarity of the dynamo. This may be detected when the machine is loaded by short circuiting the series coils. If the voltage rises in doing this the coils are in opposition, and the terminals of the series coils must be reversed.

If the shunt is so connected as to "build down" the dynamo, the machine will refuse to excite till the terminals of the shunt coils are interchanged. In closing it is well to note that it is perfectly possible to connect a field coil in such a way that it will tend to produce a polarity opposed to the magnetization to which it owes its current. If all the coils of a machine be thus connected it will refuse to build till the terminals of these coils are reversed. This is not confined to compound dynamos but applies to shunt and series dynamos also.

Electrical Engineering in the Columbian University.

In 1884, when the Columbian University moved from the outskirts of Washington into a handsome new home in the heart of the city, it was decided to add to its other schools one devoted to science. Out of gratitude to Mr. W. W. Corcoran, the wealthy banker, who had at various times generously aided the University, his name was given to the new school, and on the 1st of October, 1884, the Corcoran Scientific School was opened to the public. To accommodate young men in the government service, or otherwise employed during the day, and in accordance with the custom successfully followed by the schools of law and medicine, the classes meet in the evening between the hours of six and ten. In this realization of the university extension idea the Columbian University antedates the movement at Cambridge, England, by many years. A large number of courses in English, French, German, philosophy, mathematics, astronomy, assaying, the natural sciences, and drawing, were offered to special students and to candidates for the degree of B.S. From the beginning the school was a success, and has had a continuous and rapid growth. During the past year the number of students enrolled has been greatly in excess of previous years, notwithstanding the financial depression and the raising of the standard of admission.

The school has from the first had a large and well-equipped chemical laboratory, but for some time the experimental facilities in other departments were limited. In response to the demand for more advanced instruction in civil engineering and architecture, the courses and facilities in these studies were gradually enlarged. Two years ago the demand for practical instruction in electricity became so great that it was decided to establish a course in electrical engineering. To the courses of lectures in general physics were added several in theoretical and applied electricity, thermo dynamics, and laboratory work. New apparatus was purchased, and several valuable donations were made by the Lundell, the General Electric, and the Whitney electrical companies and other electrical firms. At present the laboratory is well equipped for undergraduate work in general physics and elementary electrical measurements. It has a 3 h. p. engine, a 1½ kilowatt dynamo, a 1 h. p. motor, several small machines, and the ordinary testing instruments. As more advanced work is demanded appropriate apparatus will be furnished. Several courses are given in shop drawing and machine construction, and it is intended at an early date to establish a work shop and mechanical laboratory. A fund for this purpose has already been partly raised.

Last year, after the appointment of Professor C. E. Munroe as dean of the faculty, there was a general re-organization of the courses leading to degrees. In accordance with the present tendency of our

best technical schools, it was decided to give the degree of civil and electrical engineer only to those who, after completing the four years course leading to the bachelor's degree, take one year of the post-graduate work in the newly-established graduate school. During the four years preliminary course, which leads to the degree of bachelor of science, the students learn chemistry, including laboratory practice; mechanical drawing, mathematics, including differential equations and theory of least squares; English, French, German, descriptive geometry, analytical and applied mechanics, machine construction, strength of materials, municipal engineering, construction of plants and buildings, general physics, with laboratory work, practical applications and mathematical theory of electricity, thermo dynamics, and elementary electrical measurements and tests. Occasional visits of inspection will be made to electrical establishments in and around Washington.

After completing this course or its equivalent, candidates for the degree of electrical engineer are required to study another year in the graduate school. Here they devote themselves to advanced work in the theory of electricity and laboratory practice, and meet every week to read papers and to discuss the current journals. In addition to passing a satisfactory examination in these subjects, they must present a written thesis embodying the result of some original investigation, or giving the complete project of an electrical plant.

In spite of limited means, the work of the Corcoran Scientific School will compare most favorably with that of any school of its class in the country. This is due in a large measure to the fact that, in addition to the services of a number of the faculty of the Columbian College, some of the most eminent specialists in the scientific bureaus of the government and in professional practice give instruction in the scientific and graduate schools, thus affording to the students the fullest opportunities to study the rich collections of which they have the custody.

Hatchet Planimeter.

In connection with the brief descriptions we have published of this instrument (see The Electrical World, June 30 and August 18), the following, taken from an interesting article in April 14, "L'Industrie Electrique," July 25, may be of interest. It is there stated that the invention was made in 1880 by Captain H. Prytz, of the Danish Army, not by Mr. Knudsen, who was the co-instructor. The complete theory by the inventor himself is given in that journal. It is stated there that to use the instrument one should commence at the centre of gravity of the surface to be measured, trace from there a straight line to the periphery, then around the periphery and back along the radial line to the centre of gravity. The distance between the initial and final positions of the hatchet end, multiplied by the length of the instrument measured from the point to the middle of the hatchet end, will give the area of the surface; if the lengths are in inches, the area will be in square inches. The error in the selection of the centre of gravity may be eliminated by tracing the figure, then turning it 180° and tracing it again; the true length will then be between these two values. If the greatest dimension of the figure is greater than half the length of the instrument, the figure should be divided into two parts and each half measured separately.

Sine Form of Curves of Alternating E. M. F.

The following communication has been received from Prof. R. A. Fessenden, from Bermuda, where he is spending the summer. The opening paragraph is an explanation of the unavoidable delay in the transmission of the letter, and is therefore omitted:

To the Editor of The Electrical World:

Sir:—I disagree entirely with the London "Electrician," and consider the sine form of curve to be the best one. It is true that, on account of the presence of iron in the circuits, a rectangular curve will give a slightly greater amount of power in a circuit for a given amount of hysteresis, but this is more than offset by the greater losses from eddy currents and by the greater cost of line and generators and motors for the rectangular curve, if the same amount of loss is to take place in both circuits. Under ordinary circumstances an irregular or rectangular shaped curve would not get very far before it would be modified so as to more closely resemble a sine curve, and one might just as well make the dynamo give the sine curve at once, and so avoid the eddy current and line losses due to the components of higher periodicity in the rectangular curve.

I do not, however, believe that it is necessary, as has been stated by some electricians, to use a surface wound armature to get a sine curve, as a sufficient approximation to that form can be obtained with a properly designed toothed armature.

The experiments of Mr. Scott, of the Westinghouse company, show that in practice, as in theory, the sine curve is the best.

I may say, in this connection, that it does not seem to have been generally noted that the sine curve is a necessity for efficient telegraphy. In January, 1891, I designed and experimented upon the system of multiplex telegraphy which Dr. Pupin has recently rediscovered, and noticed this fact. As a result, a method was devised by which the operator did not make or break the line circuit with his key, but put in circuit a device which automatically sent out sine waves into the line.

Reginald A. Fessenden.

Locomotive vs. Stationary Engines.

To the Editor of The Electrical World:

Sir:—In your issue of September 8 appears an editorial note on the relative economy of locomotive and stationary engines. The figures quoted from the report of M. Desdouits' test seem rather high; and it may be of interest in the present connection to recall the comment of the "Railroad Gazette" on tests made by John Wolff and the writer on locomotive No. 171, C. R. R. of N. J., in April, 1888:

"The steam consumed per I. H. P., as calculated from the diagrams, varies from 14.63 lbs. to 23.47 lbs., the average consumption being 20 lbs. The evaporation being slightly over 7 lbs. water per pound of coal, the consumption must have been at least 3 lbs. per I. H. P. and was probably somewhat less than 4 lbs. These figures are necessarily vague, as, unfortunately, it is impossible to calculate with any accuracy the amount of steam used from the indicator cards alone. If the average indicated power could be obtained, the amount of water used from the tank would serve as a check. The only possible method, however, of obtaining a reliable idea of the average indicated power is when the engine is making a long run at a tolerably even speed on long grades, and this condition is rarely met with in locomotive service."

The engine in question was of the Baldwin standard passenger type, single expansion, with 68-inch drivers. Indicator cards to the number of one hundred and fifty were taken, and about forty of these were calculated, including one at 76 and one at 77 miles per hour. Great care was exercised to avoid waste of water, and the total waste from all sources could not have amounted to more than 5 per cent. of the water consumption, as calculated from the cards. It should be noted that we bored out the exhaust nozzles as much as we dared, thus decreasing the back pressure and leaving enough draft to keep a satisfactory fire. During the entire test no steam was wasted by blowing off, this being prevented by a careful manipulation of the firebox door and the injector.

I am of the opinion that a locomotive engine is a very efficient steam user, as long as it is working up to capacity; but the conditions of ordinary railroad service are of such a nature that maximum loads last for only a short time during any run, and careless firemen waste steam by allowing the pop valve to work. There is no excuse for blowing off steam, the latter being an indication of careless firing.

New York. H. G. Wyncoop.

[The calculation of the consumption of water per I. H. P. from indicator diagrams, particularly in the case of high speed engines, is likely to give very unsatisfactory results, and always less than the true amount. While we do not question the care with which the tests referred to were made, an actual consumption of only 14.63 lbs. of water per I. H. P. with a single expansion locomotive engine is a figure reasonably open to doubt.—Ed.]

Underwriters' Rules.

We have received a communication from an electrician referring to a recent letter in our columns on the subject of Underiters' Rules (issue of August 18, 1894), and to the dissatisfaction existing among contractors from the different manner in which inspectors' rules are interpreted by different inspectors. He speaks of a hotel wired within a year, in the corridors and a number of rooms of which fixture cord is used in wood cleats, and in several instances drawn through walls without tubing. This job was passed by the insurance inspector, who, however, it is stated, is on very friendly terms with the central station manager who did the work. He also states that there is much dissatisfaction among electricians concerning the injustice of making them pay the charges of inspection, which, he thinks, should be borne by the insurance companies or charged in the insurance policy.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Calorific Phenomenon.—The "Bul. de la Societè Belge" for March-April-May, contains a long article by Mr. Hoho on "The Calorific Phenomenon Produced by an Electric Current by the Contact of a Solid and a Liquid." The phenomenon is the one on which the new system of heating metals is based, in which they are heated by plunging them into water while an electric current is passing. The article gives a very good summary of what has been published on the subject, beginning with the first records of the phenomenon by Davie, Hare, and others; he describes in some detail the researches of the Mr. Lagrange and the writer in this direction, showing the different results obtained under different conditions; he discusses at considerable length the more recent researches of others, especially those of Messrs. Koch and Wuellner. The paper forms probably the best resume on this subject. A short article on this subject by the same writer, which appears to be an abstract of this one, is published in the "Elek. Tech.," August 15. (See also an abstract in this issue under "Hydro-electric Heating").

Electrification of Crystals.—A British Association paper adressed to the geological section is abstracted, as far as it relates to electricity, in the Lond. "Elec. Eng.," August 24; the piezo and pyro electricity of crystals are discussed briefly, the former referring to electrification produced by strain and the latter to that produced by changing temperatures. The electrification of cooling crystals may be shown by the following interesting experiment proposed by Prof. Kundt; a mixture of red minium and yellow sulphur when passed through the meshes of a small sieve are electrified oppositely and in falling on a cooling crystal the particles adhere to the oppositely electrified region of the crystal, thus showing by the color the electrical condition of the crystal.

Electrolysis of Glass.—Prof. Roberts-Austen's paper is noticed briefly in an editorial in the Lond. "Elec.," August 24, he showed that some metallic bases like sodium may be passed through glass at as low a temperature as 200° C, under electro-chemical stress; the chemical nature of the rarified gasses in glass apparatus might be affected by constituents of the inner layers of glass; a remedy was proposed and tried by Prof. Schuster, consisting in electrolysing the basic constituents away from the inner surface of the glass, leaving a surface of pure silica, which was acomplished by passing a continuous current from the inner to the outer surface of the glass.

Rapidity of Photo-Electric Phenomena in Selenium.—"Cosmos," July 14, contains an article describing the recent researches of Mr. Majorama, in which he wishes to find how rapidly the selenium will respond; a curve is given in which the ordinates are the resistance and the abscissas the times between the luminous impression in the breaking of the circuit; he concludes from this curve that the photo-electric property of solenium is far from being instantaneous and that the action is not sufficiently rapid to solve the problem of vision at a distance.

Sources of Light.—In a short article in the "Elek. Tech.," August 15, Mr. Leisegang discusses phosphorescent light, giving some results of researches made with the light from insects.

Discharge Through Gases.—A British Association paper by Prof. J. J. Thomson is abstracted briefly in the Lond. "Elec. Eng.," August 24; he calls attention to the great influence which moisture has in starting of the discharge, and states that it is probable that if the gases be perfectly dry no discharge would take place with any tension however high; he believes that there is an intimate connection between electrical discharges and chemical changes.

Spectrum of Discharge.—A paper by Profs. Liveing and Dewar on "The Spectrum of Electric Discharge in Liquid Oxygen, Air and Nitrogen" is published in the "Phil. Mag." for August.

Seat of Electricity in Condensers.—A paper by Mr. Kleiner from the "Weid. Ann." vol. 52, p. 728, is abstracted briefly in the "Elek. Zeit." Aug. 16; he describes experiments in which the dielectric of a condenser was made of mica which after the condenser was charged, was split, each lamina being then provided with two conducting plates on the two sides, after which each of the small condensers thus formed, were discharged; the discharge showed that each of these condensers contained the same quantity of charge as was contained in the original condenser; there is therefore an analogy with a magnetic bar which, when broken into a number of parts, forms small magnets.

Coefficient of Self-Induction.—In an Academy paper by Mr. Guye, mentioned in the "L'Ind. Elec.," August 10, he gives the results of an experiment to prove the correctness of a recent theory (see Digest August 4.) for calculating geometrically the co-efficients of induction of a number of concentric systems of parellel and equidistant wires.

Electromagnetic Induction.—A mathematical article by Mr. Bryan "On Electromagnetic Induction in Plane, Cylindrical and Spherical Current Sheets, and its Representation by Moving Trails of Images," is published in the "Phil. Mag.," for August.

Analysis of Alternating Currents.—In "La Lum. Elec.," August 11, Mr. Claude describes the method of Dr. Pupin of analyzing alternating currents by resonance, and states that he, Claude, had occasion to use precisely the same method some months ago, without having had any knowledge of Dr. Pupin's description; a diagram and brief description are given.

Resonance and Interference.—A paper by Prof. John Trowbridge on "Electrical Resonance and Electrical Interference" is published in the "Phil. Mag." for August, including a plate of photographs of discharges.

Velocity of Cathode Rays.—Prof. J. J. Thomson's British association paper is discussed editorially in the Lond. "Elec.," August 24; a very close agreement between the calculated and observed velocity seems to give strength to the hypothesis of molecular motion as contrasted with the ether hypothesis.

Cathode Rays.—"La Nature," July 28, contains an article by Mr. Guillaum, including some very good illustrations of the Lenard experiments.

Propagation of Waves.—A French Academy paper by Mr. Dufour on "The Equality of the Velocities of Propagation of Very Short Electric Waves in Free Space and Along Conductors," is published in the Lond. "Elec.," August 24.

Hertzian Waves.—A British Association paper by Prof. Lodge, is abstracted in the Lond. "Elec. Eng.," August 24, but the abstract appears to contain nothing that has not been published before.

Magnetization by Hertzian Currents.—A French Academy paper by Mr. Birkeland is published in the Lond. "Elec.," August 24.

Electric Diffusion.—Some interesting experiments like those mentioned in the Digest July 14, under a new phenomenon," are described by Mr. Lehman in the "Electro-chem. Zeit.," for July.

Electrification of Air.—A paper by Lord Kelvin and Mr. Maclean is published in the "Phil. Mag." for August.

Resistance of Copper-Zinc Alloys.—A paper by Mr. Haas from the "Wied. Ann.," vol. 52, p. 673, on the "Specific Resistance and the Temperature Coefficient of Copper-Zinc Alloys," is abstracted in the "Elek Zeit.," Aug 16; and Lond. "Elec.," Aug. 24; he finds from the examination of a number of different alloys of copper and zinc that the maximum specific resistance and the minimum temperature coefficient are obtained when the alloy consists of about one-third zinc and two-thirds copper, from which he concludes that it is very probable that these metals form a chemical union in this proportion; he suggests that the valuable properties of such a brass may be due to the existence of such a chemical union.

Formation of Floating Metallic Laminae.—The article by Messrs. Mylius & Fromm is abstracted briefly in the "Phil. Mag.," for August.

Electricity from Carbon Dioxide.—The Lond. "Elec. Rev.," August 17, recommends a paper by Mr. Bleekrode in the "Phil. Mag." for July, on the production of electricity by the evaporation of liquid carbon dioxide.

Researches with Tesla Currents.—An abstract of a paper by Mr. Himstedt, published in the *Elek. Zeit.*, July 12, will be found translated in full in another column of the present issue.

Dialectric Constants.—The Lond. "Elec. Rev.," August 17, calls attention to a recent paper by Messrs. Jahn & Moeller.

Dialectric Polarization of Liquids.—A paper by Mr. Stankewitz is abstracted in the "Elek. Zeit.," August 16.

MAGNETISM.

Magnetization of Iron Cylinders.—A paper by Mr. Grotrian from the "Wied. Ann.," vol. 52, p. 735, is abstracted in the "Elek. Zeit.," Aug. 16. He argues in favor of a statement made by him some time ago that, with weak magnetising forces the outer layers of the iron become magnetized first; as a proof of this he states that when iron filings are placed on the top of an electro-magnet, the greater portion will be attracted toward the edges; if the field is measured at different parts of the end of such a magnet, it will be found to be greater near the edges than near the middle; if iron filings are introduced in a hollow magnet they will not adhere strongly to the inner walls of the tube; these experiments, he claims, show plainly the presence of a screening action; if a short hollow cylinder is used more magnetism will be found to exist in the center of the air space than in that near the iron, which latter space will be screened by the iron more than the central portion will be.

Law of the Magnetization of Iron.—The "Elek. Zeit.," August 16, contains an article by Dr Culmann, criticising Dr. Froelich's recent article; it appears to be the same as that mentioned in the Digest Sept. 16.

Bismuth in Magnetic Fields.—Some data from recent researches of Prof. Raymond are given briefly in the Lond. "Elec. Rev.," August 17.

Manganese Steel.—The Lond. "Elec. Rev.," August 24, contains an abstract, a translation of the article in the Digest September 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Practical Standards.—The Report of the Electrical Standards Committee of the British Association on "Experiments for Improving the Construction of Practical Standards for Electrical Measurements" is published, apparently in full, in the Lond. "Elec. Eng.," August 24. It consists of a number of appendixes; a table is also given of the coils in the Cavendish Laboratory. It contains a paper by Prof. J. V. Jones on "A Determination of the International Ohm in Absolute Measure," in which he describes the Lorenz method and the results of a number of tests, giving the value of the International ohm in true ohms, from which he finds that the true ohm in mercury units is 106.326 cm; he discusses at some length the accuracy on which the results depend; he concludes that the chief value of these observations consists in the proof which they afford of the precision with which the absolute measurement of resistance may be made with this method; he believes that well constructed apparatus of this kind in a national laboratory will prove to be the best ultimate standard of electrical resistance. Some articles by Messrs. Glaebrook, Rennie and Walker give comparisons of some standards. In an article by Mr. Fitspatrick he reduces to the same units experimental results recently obtained by various observers of the specific resistance of copper and silver; he gives the results in terms of weight and length in preference to cross-section and length, stating his reasons, one of which is that the different densities affect the results much more in one case than in the other; results are given for hard and annealed copper and silver and of the temperature co-efficients; he concludes that the specific resistance depends not only on the purity of the material but on a number of other factors which are different in different wires of the same material, and that we can therefore not expect to attain any great degree of accuracy in the determination of specific resistances.

Low Resistance Standards.—A British Association paper by Prof. Jones is published briefly in the Lond. "Elec. Rev.," Aug. 24; he has succeeded in making standards so that they adequately fulfil all requirements for resistances from 0.001 to 0.0001, with an accuracy of one part in ten thousand; he points out the care which must be exercised with the four connecting points, two for the current and two for the potential circuit; a detailed description is promised in the near future.

Measuring Lag and Lead.—Mr. Kennedy, in the Lond. "Elec. Rev.," Aug. 24, calls attention to some further points which may be learned from the synchronous photograph mentioned in the Digest last week; the position of the field poles in relation to the armature coils is shown at the moment of maximum current, thus affording a means of measuring the lag between the E. M. F. and the current; this measurement would lead directly to a method of observing the leads and lags in alternating motor armatures under varying excitement.

Measuring the Magnetic Qualities of Iron.—In a communication to the Lond. "Elec.," Aug. 24, Dr. Koepsel gives a number of curves of magnetization obtained by his apparatus, belonging to the communicative abstracts in the Digest September 1.

Instrument for Testing Iron.—The one described in the Digest Aug. 18, is illustrated and described in the "Elek. Zeit.," Aug. 23.

Ampere and Volt-meters for Alternating Currents.—In the "Elek. Zeit.," Aug. 23, Mr. Penkert describes an instrument based on the principle discovered by Prof. Elihu Thomson, in which a closed metallic ring is repelled by an electromagnet. A copper ring is placed near the middle of a long iron core and directly over a short exciting coil, the ring being suspended on a pivoted lever and balanced by a counterweight, a pointer indicating the deflection of the lever; he obtains an almost exactly proportional scale for nearly the whole range; some calibration curves show that the constants are not the same for different frequencies, although they do not differ very greatly; the deflection is nearly dead-beat; the principle advantage of the instrument is its extreme simplicity; he believes this to be the first instrument constructed on this principle (in which, however, he is mistaken, as Prof. Thomson himself devised measuring instruments based on this principle at least four years ago).

Construction of Delicate Galvanometers.—Prof. Schuster's British Association paper, mentioned in the Digest last week, is published in full in the Lond. "Elec.," August 24.

Direct Reading Platinum Thermometer.—A British Association paper by Mr. Clark is published in the Lond. "Elec. Eng.," Aug. 24; the thermometer is based on the changes in the resistance of a platinum wire; it is claimed that although this and the mercury thermometers both depart somewhat from that of the air thermometer, the departure is not greater in one case than in the other and the readings of one can therefore be accepted as well as those of the other; the instrument is described at some length.

[illegible]tameter.—A complete and convenient form by Mr. Naber, said to be adapted to making measurements of great accuracy, is described and illustrated in the Lond. "Elec.," Aug. 17; it collects the mixed gases and eliminates certain errors and reductions.

Chronograph.—A British Association paper by Messrs. Lea and Bragge is given in abstract in the Lond. "Elec. Eng.," Aug. 17; the chronograph was specially constructed for use in testing meters; the description does not admit of being abstracted.

Motors vs. Mechanical Transmission.—The serial by Mr. Brunswick in "La Lum. Elec.," Aug. 11, on the Siemens & Halske machinery, contains the quantitative results of some extended tests made in order to compare the running of machine tools directly by electric motors and by belt and shaft transmission; the results do not admit of being abstracted; he divides the cases under three classes, a single motor for the whole factory, a motor for each of a number of groups, and a motor for each machine, and shows that every case must be considered by itself; the second case is of advantage specially when power is sold by the factory, as the electric motor forms a true dynamometer, the power consumed being indicated by the meter.

Factories Driven by Electric Motors.—The paper read at Brussels by Mr. Selby-Bigge on "Electric Power, with Special References to Works Driven by Electricity in Belgium," is abstracted in the Lond. "Elec. Eng.," Aug. 24; it gives some information of the successful installation of about 600 h. p. at the National Arms Factory at Herstal, also at some zinc works near Jemeppe.

Opening Circuits Containing Magnets.—In the "Elek. Zeit.," Aug. 16, Mr. Egger describes a method for preventing the formation of sparks in the opening of a dynamo circuit due to the self-induction of the field magnet; the adjustable field resistance is so arranged that after inserting the whole resistance the next knob forms a short circuit of the field, in which the self-induction current is dissipated. He shows that some such method is of greater importance with motors whose direction of rotation is to be changed often, as, for instance, for elevators; he describes, with the aid of an illustration, the various steps in a switch which he has constructed for starting, stopping and reversing motors, in which the self-induction currents from the field magnets on stopping, is discharged through the armature and regulating resistance.

Electricity on Vessels.—An article by Mr. Brancher is abstracted in "La Lum. Elec.," Aug. 11, from "Genie Civile," July 14; illustrations are given of electric motors for turning the turrets and for directing the cannon.

Armature Winding.—Under the head of a "New Form of Winding," Mr. Tauligne, in "Cosmos," July 21, describes a well-known system of winding a disk armature for a multipolar machine.

Sine Curve Alternators.—A communication from Mr. Steinmetz is published in the Lond. "Elec.," Aug. 24.

TRANSFORMERS.

Cooling Transformers.—According to a number of foreign journals the Oerlikon Company cool a large transformer of 170 kilowatts by circulating oil around it with the aid of a special pump, the oil being that used for insulation; in this transformer 3.5 kilowatts must thus be dissipated.

ELECTRIC RAILWAYS.

Electricity on Common Roads.—An article in the Lond. "Elec. Rev.," Aug. 10, suggests and recommends using electric traction to bring farmers' goods from the suburbs to the centres of large cities, the current being taken, it seems, from lines running along the route; it is claimed that the roads are very good (from which it appears that rails are not to be used); the power is to be derived from electric lighting stations, and as it would be required for both journeys during the hours of least demand for current, the system would be of benefit to the existing lighting stations and the only outlay for the scheme would be that of the poles and conductors (provided the station voltage is suitable). In the beginning of the article it is stated that "the hopes of some electricians as to the possibilities of electric traction on ordinary railroads are not likely to be fulfilled by the adoption of any known system of electrical working;" the most that can be reasonably claimed is the running of through trains from point to point, but the general application of electric traction "cannot be entertained by any sober thinking man, and even the partial application to through express passenger traffic is very improbable."

Fly-wheel Accumulators.—In a correspondence to the Lond. "Elec," Aug. 17, Mr. Swinton points out the advantage of using such accumulators in electric traction in connection with the steam turbine, stating that at about 4,000 revolutions per minute a solid cylindrical fly-wheel 3 ft. in diameter and 3 ft. wide, weighing about six tons, will store energy enough to maintain 66 h. p. for two minutes with a 5 per cent. variation in speed; the peripheral speed would be 666 ft. per second, and he thinks it would be quite safe to use solid steel, as he believes considerably higher speeds are used with similar fly-wheels employed in the Howell torpedo; he also suggests the use of such fly-wheels for electric welding plants. In an editorial it is thought that it would not be safe to use such a wheel of solid steel; attention is also called to the proposition of Forbes and Halpin, in which the fly-wheel rim is of channel section, wound full with steel wire under tension, and it is thought that besides being less expensive this may possibly provide a safe fly-wheel for such speeds.

Douglas-Laxey Railway.—A full description, accompanied by a number of good illustrations, and a profile of the road, are published in the Lond. "Elec. Rev.," Aug. 24; as stated in the Digest last week, a storage battery is connected to the line nearly midway between the two generating stations; it appears that this is charged or discharged according to the requirements of the traffic, being generally connected in parallel with the generating station; it can be brought up to full charge at any time by a motor generator placed in the accumulator station; in the winter when only two cars a day are run, the accumulator furnishes the whole power, being charged about once a week; the latter is said to be the reason why accumulators were introduced.

Liverpool Railway.—The Institution paper by Messrs. Greathead & Fox, abstracted in the Digest, March 24-31, is being reprinted in the Lond. "Elec.," beginning with the issue of Aug. 24.

Accumulator Road in Paris.—A descriptive article, accompanied by a number of diagramatic and working drawings, is given in the "Elek. Anz.," Aug. 23.

Railways in Europe.—Some data regarding the railways at Brussels, Hamburg, Dresden, Essen, Milan and Gera, are published in the Lond. "Elec. Eng.," Aug. 24.

Canal Boat Traction.—A few figures obtained experimentally by the French Government are given in the Lond. "Elec. Rev." Aug. 24.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Alternating Current Systems.—Prof. S. P. Thompson's British Association paper (see The Electrical World, Sept. 1.) is discussed unfavorably in an editorial in the Lond. "Elec.," Aug. 24. The same subject is discussed in an anonymous article on "Transmission and Distribution of Electrical Energy" in the Lond. "Elec. Rev.," Aug. 24, in which it is pointed out that in the present state of the art no one should pin himself to the dogma that one system is sufficient to meet every case.

Alternating vs. Direct Currents.—The statement made by Prof. S. P. Thompson that there is less likelihood of trouble from leaks in alternating than in direct current leads, is discussed unfavorably in an editorial in the Lond. "Elec. Rev.," Aug. 24, in which it is stated that experience with submarine cables teaches that in order to break down a fault the application of rapidly alternating currents is one of the most effectual means to employ.

Accumulators Used With Motors—In the first part of an article by Mr. Darrius in "L'Elec," Aug. 18, he mentions a system in which a motor is run from a battery of accumulators at variable speeds by coupling all the cells in groups connected in quantity and series in various combinations; he points out that in coupling accumulators in parallel there is always a loss of energy, owing to the fact that there is always more or less difference of potential between individual cells, in which case one will charge the other. (Quantitative results ought to be given, as this charging automatically tends to equalize the E.M.F's., thereby diminishing the loss).

Electric Machines and Apparatus.—Some illustrations of various apparatus made by The General Electric Company of Berlin, are given in the Lond. "Elec. Eng.," Aug. 24, including a dynamo, a shunt regulator, an electric elevator, and apparatus for the intermittent lighting of staircases and a switch.

Arundel Castle.—A well illustrated description of this installation is given in the Lond. "Elec. Rev.," Aug. 24; Mr. Kapp was the consulting engineer. Some illustrations accompanied by a short description are also given in the Lond. "Elec. Eng." , The plant is also described in another column of this issue.

High Tension Fault Detector.—The Lowrie-Hall detector is illustrated and described in London "Lightning," Aug. 23; it consists of a vacuum tube, one pole of which is connected to line and the other to earth; when the insulation is good the tube will glow, but if there is any fault the glow will be proportionately diminished.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Photographing Telephone Vibrations.—The Lond. "Elec. Eng.," Aug. 24, describes the process of Mr. Burch who has succeeded in making an instrument by means of which the E.M.F.'s generated by a telephone can be recorded photographically; the measuring instrument is the Lippmann capillary electrometer, by means of which electrical changes occurring thousands of times in a second can be recorded by photographing the magnified image of the capillary tube on a moving sensitive photographic film.

Telegraph Lines of the World.—Some statistics for the different countries are given in the "Zeit. feur Elek.," Aug. 15; the total length of lines in the world is given as about 1,006,000 miles, of which 540,000 are in America and 380,000 in Europe; in the United States there are about 400,000 miles, which is the greatest in any one country.

The Telegraph and the War in the East.—A brief article by Mr. Morris on the telegraph in Japan and Korea is published in the Lond. "Elec.," Aug. 17.

French and British Submarine Telegraph Companies.—An article, chiefly of local interest, is published in the Lond. "Elec.," Aug. 17.

Pantelegraph.—The Cerebotani system is described and illustrated in the "Elek. Anz," Aug. 16.

Telephony.—The "Elek. Zeit.," Aug. 16, contains an article of some length, forming the first part of a series on studies in telephony; the present portion is devoted to a discussion of the management, operation, charging, etc.

Military Telephone Line.—The "Zeit. feur Elek.," Aug. 15, describes the laying of about 18 miles of a military telephone circuit in four hours, forming part of the exercises of the German army; the line was supported on the branches of trees and was started at the two end points simultaneously.

Switch for Suburban Lines.—The "Zeit. feur Elek.," Aug. 15, publishes at considerable length a description, taken from a recent work by Pierard, of a switch used in Belgium; the description includes 12 illustrations.

Telephone Apparatus.—That made by Berliner, of Hanover, is illustrated in the "Elek. Anz.," Aug. 12.

The Government and the Telephone.—A summary of the draft agreement between the English Government and the telephone companies is published and discussed editorially in the Lond. "Elec. Eng.," Aug. 17.

The British Government and the Telephone.—The subject is discussed editorially in the Lond. "Elec. Rev.," August 24.

Fire Alarms.—A new system, at present exhibited in London, is described in the Lond. "Elec." Aug. 17.

Fire Alarm System.—The Fogl system which embodies an improvement, making it operative even in case of certain temporary failures in the line, is illustrated and described briefly in the "Elek. Zeit.," Aug. 23.

London-Berlin Telephone.—Negotiations are being opened for the construction of direct telephone communication between London and Brussels via Ostend, to which a line will be added to Berlin.

Pacific Cable.—The Lond. "Elec. Eng.," Aug. 24, reprints an article from the London "Times" on this subject.

ELECTRO-CHEMISTRY.

Electro-Chemical Relations of Carbon.—An article by Mr. Brooks on "The Electro-chemical Relations of Carbons at High Temperatures" is begun in the Lond. "Elec. Rev.," Aug.17; he gives a short account of a number of interesting experiments which were more or less successful, with the direct production of electricity from carbon, among which are some with the thermo-electric properties of copper sulphide; in most cases quantitative results are given; he states that the potassic nitrate reaction in carbon cells is unsuitable, as it is apt to become uncontrollably violent; the obstacle in such cells lies in the difficulty in finding a material for the negative plate, and he obtained no satisfactory results until he abandoned the use of metals altogether; from the calorific equivalent of the combination of the carbon and oxygen he obtains a calculated E. M. F. of 1.05 volts, which is a low value for such an intense reaction and is due to the fact that a large amount of energy is expended in changing the molecular state of the carbon; this value can be exceeded, as nearly 2 volts have been obtained by experiments under suitable conditions, the probable explanation of which is that some of the energy is supplied from sources independent of the reaction itself. The article is concluded in the issue of Aug. 24; he describes a number of experiments with different cells, one of which he calls "a really efficient carbon cell, which is a distinct advance on any previous attempts in this direction;" the electrolyte in this cell appears to be $K^2 S^2 O^7$ contained in a somewhat porous crucible; sulphuric acid is the oxidizing substance, the potassium salt serving as a carrier between the soda and the carbon; it appears to have an E. M. F. of 1.57 volts and an internal resistance of 3 ohms; the burning coke of the fire appears to be the positive element, and it seems that carbon rods are also used as the negative element, in the crucible; metals are entirely eliminated.

A New Depolariser.—Mr. Oppermann, in the "Electro-chem. Zeit.," for July describes at some length a new depolariser and a battery which he recommends very highly; instead of nitric acid which, aside from other objections, is very uneconomical, he uses the well-known reagent for phosphoric acid, namely, a solution of the double salt of molybdenum and ammonia in nitric acid; by using the commercial materials it is not expensive; the E.M. F. is not lowered but, on the contrary, the new depolariser seems to be even more active; an objectionable gas, however, is evolved and he therefore covers the porous cup with a lid of peculiar construction, into which a liquid is poured which absorbs these gases, the liquid being a concentrated solution of permanganate of potash; this must be renewed by the addition of liquid, from the outside, the resulting liquid running into the cell where it again becomes active; for the exciting liquid he prefers a concentrated solution of kitchen salt or salammoniac; the volume of this should be aobut 4 times that of the depolariser in the porous cup; he gives his experience with a number of these cells for large currents.

A New Primary Cell.—In the "Elec. Echo," Aug. 11, Mr. Oppermann suggests a cell in which the carbon is in a concentrated solution of copper sulphate and the zinc in a solution of sodium and potassium tarrate, (Rochelle salt) to which sugar is added, the liquids being separated by a porous cup; the E. M. F. is surprisingly high, being 1.6 to 1.8 volts; the preparation of the liquids is described in the article.

Portable Battery.—In a communication to the Lond. "Elec. Rev.," Aug. 24, Mr. Fitzgerald gives briefly the results of some tests and

concludes that within a weight of 4 lbs. a battery could certainly be constructed which would give an output of 12 watts at intervals for many periods of a few minutes. The Lond "Elec. Eng.," Aug. 24, calls attention to some portable accumulators sold by a London firm.

Dry Cell.—According to the "Elek. Tech.," Aug. 15, the Lessing cell contains no salts which have a tendency to crystalize or whose components can generate a gas; no futher information is given except that it is a cell of the Leclanche type.

Accumulators.—According to "La Lum. Elec.," Aug. 11, one of the methods of Mr. Pollak is to make a thick paste of carbonate of lead with caustic potash; after mixing and drying a current is passed which reduces it to spongy lead.

Purification of Sugar.—The Weyde & Lugo process is briefly described in "La Lum. Elec.," Aug. 11; the juices are heated to 93° C. and a crurrent passed through them, using an aluminium cathode and a carbon anode; 4 to 5 volts are required; aluminium hydrate is produced, which coagulates and carries down the impurities; 5 to 10 minutes are sufficient.

Aluminium and Its Electro-Metallurgy.—The serial by Mr. Richards is continued at some length in "La Lum. Elec.," Aug. 11.

MISCELLANEOUS.

Hydro-Electric Heating.—An article by Mr. Feukert describing the Lagrange & Hoho process, in which metal is heated by a current while immersed in a liquid, (see Digest May 26,) is contained in the "Electrochem. Zeit." for August; some interesting data is given, but there is apparently nothing that has not been published before. A good liquid is obtained by dissolving 20 per cent. of potash in the water; he shows that the temperature of the bath is of considerable importance and finds that 104° to 122° F, is about the best; a useful application is in the cleaning of iron objects of rust; a short immersion of a rusty iron bar cleanses it thoroughly. (See also an abstract in this issue on "Calorific Phenomenon").

Electricity in Metallurgical Operations.—The Lond. "Elec. Rev.," August 17, describes briefly the suggestion of Mr. Garnier to indicate the progress in metallurgical furnaces by the changes in the electrical conductivity of a mixture of a metallic oxide placed in a tube; the process was described in the Digest, April 21.

Magnetic Chain Towing.—"Cosmos," July 14, gives a drawing of the machinery used with the de Bovet system (see Digest, August 25 and September 1).

Electric Organ.—A descriptive article, with illustrations of the mechanism, is published in "Cosmos," July 21.

Crane.—A large 20-ton electric traveling crane used in the Siemens & Halske factory is illustrated and described in "La Lum. Elec.," August 11.

British Association.—A number of the papers read at the recent meeting are contained in the English journals of August 24.

A New Meter for Alternating Currents.

BY WM. S. RESOR.

One of the problems which has confronted electrical engineers has been the invention of a commercial alternating current recording meter, which will record all loads correctly. The credit of having solved this

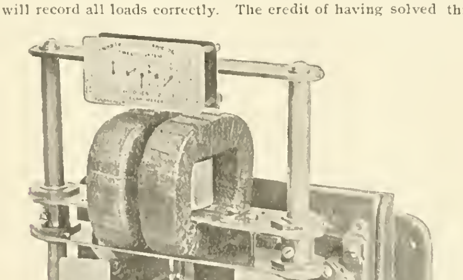


FIG. 1. DUNCAN METER.

problem must be given to Mr. Thomas Duncan, of the Fort Wayne Electric Corporation, Fort Wayne, Ind.

In the early days of electric lighting it was customary to charge so much per lamp per week, month or year, because there were no practical recording meters. This was, of course, most unsatisfactory both to supply companies and to consumers. A recording meter was the dream of both.

Before long various types of recording meters appeared, which recorded, it is true, but gave no satisfaction; for the greater part of them made electric light very cheap for the small consumers, and very expen-

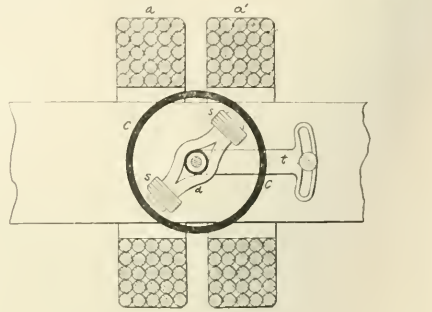


FIG. 2.

sive for the large, on account of the slow speed on a small number of lights, and the high speed on a large number. But each has in turn been succeeded by others, claimed to be better, and now the Duncan meter seems to have reached the end of the line, and combines, let us hope, the virtues of all and the defects of none.

This meter is dependent on the principle of the repulsion of a closed secondary from its primary, and is a thoroughly practical and efficient

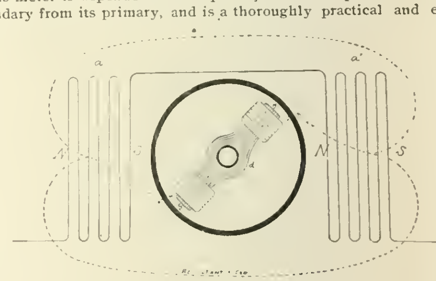


FIG. 3.

development of Prof. Elihu Thomson's classical experiments on that principle.

The essential parts of the meter, shown complete in Fig. 1, are the primary or field coils a a' (see Fig. 2), which are connected in series with the lamp circuit; the secondary or armature c, consisting of an aluminium cylinder, a magnetic path diverter, made of laminated iron, and carrying a closed secondary s, which consists of several copper punchings; the aluminium fans, the registering train, and the spindle which carries said armature and fans.

A very important feature of this meter is that there are no brushes or commutator to get out of order or other contacts to become dirty

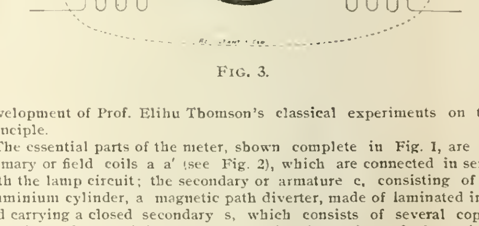


FIG. 4.

and oxidized. The armature has no electrical connection with the circuit.

The motion of the armature or cylinder is due to the repulsion set up against it as a closed secondary, from the primary or field coils a and a'.

The action is explained more fully as follows: When the lamps are turned on the current flows through the coils a and a', and an alternating field is set up. This field is distorted or diverted from its natural direction, along the axes of a and a', by the diverter d, and assumes a form similar to that shown in Fig. 3. Foucault currents are generated

in the armature and also in the closed secondary on the diverter. The use of this secondary on the diverter is to reverse its polarity.

Suppose we considered the instant when the polarity of the primary or field coils a and a′ are as shown in Fig. 3; the flux as it cuts through the cylinder obliquely, and as shown by the dotted line, will develop Foucault currents in it, which will have poles as shown in the diagram, i. e., a south pole on the outside circumference of the cylinder and facing the south pole s of the primary coil a, thereby setting up a repulsion, due to their being of the same polarity. Again, the north pole end which is shown on the inner circumference of the cylinder will be attracted by the south pole s of the diverter d. Therefore, the rotation is due to the repulsion set up by the two south poles on the outside of the cylinder, and the attraction between the two unlike poles

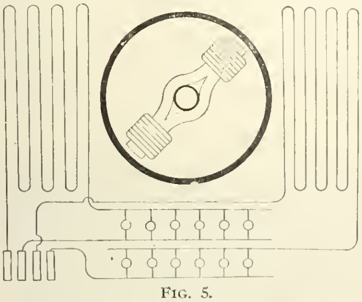


FIG. 5.

inside. The same condition exists on the other or right hand side of the cylinder, only differing in the change of polarity.

The closed secondary, which is divided into two parts, each half being placed upon the respective poles of the diverter b, is for the purpose of changing the original or induced polarity of said diverter, so as to obtain a maximum tongue in effecting an attraction between the induced poles on the inner surface of the cylinder and the diverter.

If the axis of the diverter be placed along the axis of the coils d and a′, or at right angles to it, there will be no motion, all the energy being expended in producing a lateral pressure on the shaft, but as soon as we move it from either of these positions, the force acts along a line which does not pass through the vertical axis, hence we have motion whose speed depends on the size of the angle formed by the two axes. Forty-five degrees gives the greatest speed.

This meter is the only one upon the market whose speed curve is a straight line.

The following table contains the results of a test on a twelve-light Duncan meter.

No. of Lamps.	Revs. Min.	Initial Speed.	Per Cent. Error.
1	14	14	6.6
2	30	15	0
3	45	15	0
4	60	15	0
5	75	15	0
6	90	15	0
7	105	15	0
8	120	15	0
9	135	15	0
10	150	15	0
11	165	15	0
12	180	15	0
13	195	15	0
14	210	15	0
15	225	15	0

The speed on one light is a few per cent. slow, on some as low as two per cent, but on all other loads the meter is correct. The following table shows the result of a test on a twenty-five light meter:

No. of Lamps.	Revs. Min.	Initial Speed.	Per Cent. Error.
1	9	9	10
2	20	10	0
3	30	10	0
4	40	10	0
5	50	10	0
6	60	10	0
7	70	10	0
8	80	10	0
9	90	10	0
10	100	10	0
11	110	10	0
12	120	10	9
13	130	10	0
14	140	10	0
15	150	10	0
16	160	10	0
17	170	10	0
18	180	10	0
19	190	10	0
20	200	10	0
21	210	10	0
22	220	10	0
23	230	10	0
24	240	10	0
25	250	10	0

The test of a fifty-light meter gave the following data:

No. of Lamps.	Revs. Min.	Initial Speed.	Per Cent. Error.
1	4¼	4¼	15
2	10	5	0
4	20	5	0
6	30	5	0
8	40	5	0
10	50	5	0
12	60	5	0
14	70	5	0
16	80	5	0
18	90	5	0
20	100	5	0
22	110	5	0
24	120	5	0
26	130	5	0
28	140	5	0
30	150	5	0
32	160	5	0
34	170	5	0
36	180	5	0
38	190	5	0
40	200	5	0
42	210	5	0
44	220	5	0
46	230	5	0
48	240	5	0
50	250	5	0

Fig. 4 is an initial speed curve for a twenty-five light meter, and shows the remarkable constancy which the meter maintains throughout its entire range.

Mr. Duncan has also applied this principle to meters for measuring and recording multi-phase currents, and with particular success in the

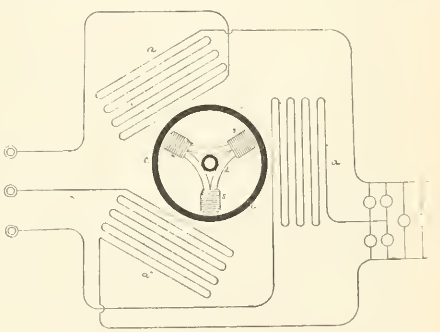


FIG. 6.

cases of two and three-phase currents; also as a wattmeter for measuring the total energy:

Fig. 5 shows a two-phase, and Fig. 6 a three-phase meter.

A striking peculiarity of the multi-phase current meter is that it can be operated with single phase currents, by simply connecting its field coils in series or multiple arc, and in series with the lamps.

New Books.

HOW TO BECOME A SUCCESSFUL ELECTRICIAN. The Studies to be Followed, Methods of Work, Fields of Operation and Ethics of the Profession. By T. O'Conor Sloane, Ph. D. New York: Norman W. Henley & Co., 189 pages, illustrated. Price, $1.00.

This is a well-written work on what might be called the general philosophy of technical education, and the ethics of professional life. He will be disappointed who expects to find mapped out a definite programme to be followed, though much detailed information is given. Nor, we fear, will the views of the writer as to the kind and sequence of studies to be pursued by the would-be successful electrician, meet the full approbation of electrical engineers or professors of electrical engineering. The work, however, inculcates the proper principles and lays down good general methods of study, so that those who go to this book and do not find the practical guidance expected will nevertheless receive a full equivalent. In these days when instruction rather than education is the rule, and when intellectual honesty and the ethical features of professional life receive so little attention, such a book as this has its value, and might well be read by every student, though through it alone he may not be able to attain the promise given in the title. Many of the general suggestions as to the direction of studies desirable in order to attack some of the unsolved problems in practical electrical science, would be useful to the full-fledged engineer, and the agreeable style of the author will also render the work pleasant reading to others than those whom its title addresses.

ELECTRICAL MEASUREMENTS FOR AMATEURS. By Edward Trevert, 1894. Lynn: Bubier Publishing Company. 117 pages, 46 illustrations. Price, $1.00.

This little book, we are informed by the preface, is written for

amateurs. It contains descriptions of the Wheatstone and slide wire bridges, with directions for their use, and describes the Clark cell, a magnetometer and several forms of galvanometers, ammeters and voltmeters. The work is a mere compilation, but the portion relating to the Wheatstone bridge may be found useful by learners.

HOW TO MAKE AND USE THE TELEPHONE. By George H. Cary, A. M. A Practical Treatise for Amateurs. With Working Drawings. Lynn: Bubier Publishing Company. 117 pages, 26 illustrations. Price, $1.00.

This small volume, which is far from deserving the sub-title of "Treatise," contains reprints of a lecture on the telephone by Prof. Puffer, two descriptions of how to make a receiver, extracted from an English and American book respectively, and directions how to make a phonograph, taken from an English journal. Several other portions of the book deal with matters connected with telephony, one chapter having dimensioned cuts of a magneto bell, which, however, very inadequately represent the mechanism. There are also dimensioned cuts of a Blake transmitter and of a Bell receiver. The information in the book is patchy in character and many of the cuts are very poor, but it contains considerable matter that may interest amateurs.

ELECTRICIANS' MANUAL OF DIAGRAMS. By E. W. Smith. Philadelphia: Scientific Publishing Company of Pennsylvania. 93 pages, 45 plates. Price, 50 cents.

To the learner and the amateur this little collection of diagrams will be of interest. It consists of 45 plates containing diagrams of circuits for the installation of electric bells, gas-lighting apparatus and telephones, and of circuits and connections for telegraph instruments, a storage battery system and electric lighting. There are 15 plates of dynamo connections, one showing how to connect a condenser with an induction coil and several plates illustrating various details.

THE MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Every Day Use. By Norman Hughes. London: E. & F. N. Spon. 1894. 80 pages, 24 illustrations. Price, $1.00.

The following definition is an index to the character of the matter contained in this book: "The word current is used to imply the passage or flow of electricity and to indicate its quantity when specified. If two pieces of metal or certain other substances be partly immersed in suitable fluid, a current is set in motion from one to the other, provided the ends touch which are out of the fluid, or connected by a wire, etc." We are also informed that copper "conducts some twelve times as well" as iron, which gives the latter a resistivity double its real amount. The description of a commercial telephone refers to a half-tone illustration in which the details are indistinguishable, and the line cuts throughout the work are inexcusably poor. After informing the readers that the telephone user will probably never need a closed circuit battery, several pages are devoted to it— about the same amount of space given to directions how to make a "battery telephone." While here and there some useful information to the amateur may be found, it yet belongs to the class of books that might as well have never been written.

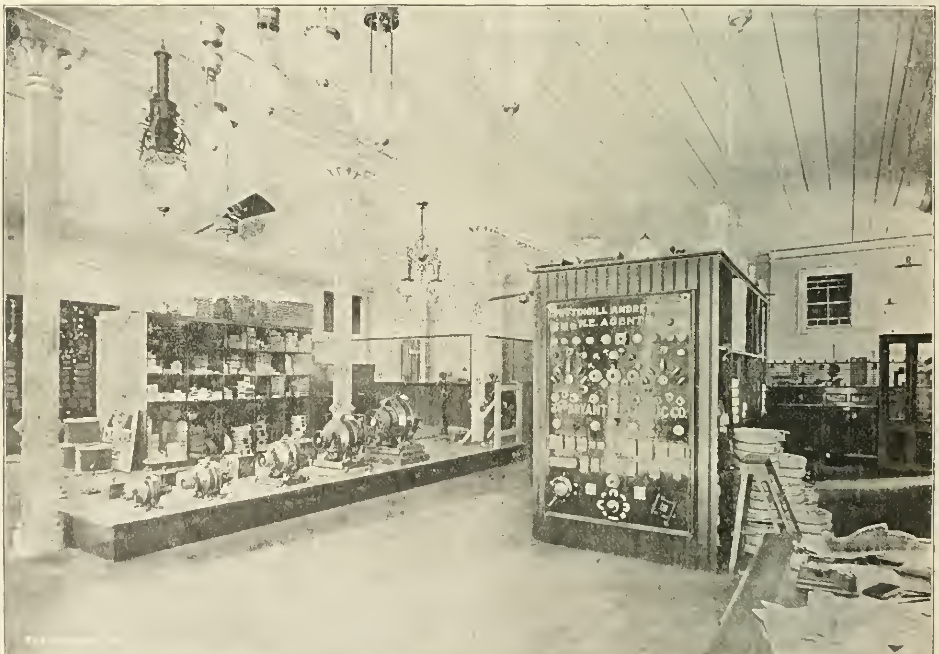
PROGRESS IN FLYING MACHINES. By O. Chanute, C. E. New York: The American Engineer and Railroad Journal. 308 pages, 90 illustrations. Price, $2.50.

This book gives an historical review of the efforts and experiments of inventors to accomplish flight with apparatus, which, by reason of its rapid movement, will be supported by the air as birds are. The author has gathered all the records of such experiments which were accessible, and has endeavored to show the reasons for their failure and to explain the principles which govern flight, and to satisfy himelf and his readers whether we may reasonably hope eventually to fly through the air. His conclusion is that this question may now be anwered in the affirmative. A full account is given of the recent experiments of scientists like Maxim, Lilienthal, Hargraves and Langley, which have so greatly added to our knowledge of this subject.

Two Enterprising New England Firms.

The accompanying illustrations, presenting interior views of the well-known electrical supply establishment of the Pettingell-Andrews Co. and the Ziegler Electric Co., both of Boston, Mass., and located in the same building, afford abundant proof that these two successful corporations are snugly housed for the transaction of their already large and rapidly growing business.

The Pettingell-Andrews Co. is, and has every reason to be, proud of its new quarters. The view illustrated shows a portion only of its handsome offices and spacious salesroom, which are situated on the street floor, and in which is neatly and artistically displayed all the various appliances used in the different branches of the electrical industry.



A CORNER IN THE PETTINGELL-ANDREWS COMPANY'S OFFICES AND SALESROOMS.

In one portion of the space is a sample octagonal pole with cross arms, pins, insulators, and cross arm braces complete, as well as a pole bracket for trolley wire support. Suspended from the ceiling or attached to special electroliers are arc lamps of the General Incandescent Arc Light Co. On a stand in a prominent position is an exhibit of the various styles of the well-known specialties of the Bryant Electric Co., while on another show board are arranged samples of different makes of push buttons, bells, flush and other switches and similar small devices. At the opposite end of the room is a fine display of interior conduit material, fuse and junction boxes, couplings and the like. In the central portion of the room are arranged a series of Lundell motors, from the smallest fan motor up to one of 15 h. p. There are some of them in actual operation and attract much attention by their neatness of appear-

ance and silence in running. The two large cases shown in our illustration are filled with all the small paraphernalia used in incandescent and other kinds of wiring, such as rosettes, plug and stop fuses, cleats, porcelain knobs, flexible cord, tubes, tape and the like. On the white marble switchboard shown on the left are samples of station switches and Whitney instruments, while in the show windows extending round three sides of the block are coils of telephone cable, Okonite and other wires and a general assortment of supplies.

The private offices of Mr. D. A. Andrews, Jr., vice-president and treasurer, and Mr. C. B. Price, secretary and general manager, are located in the rear of the salesroom, as are also the bookkeeping and cashier's departments, and offices of purchasing agent and stenographer, all of which are neatly and conveniently arranged, while distributed in various parts of the room are to be found the desks of the managers of the several business departments of the company.

In the basement directly underneath the salesroom, and more spacious even, because of sidewalk advantages, with plenty of light and ventilation, are carried in bulk all supplies, and excellent facilities are afforded for receiving and shipping.

Taken as a whole there are but few establishments, if any, which can boast of more elegant surroundings and admirable facilities for the conduct of business, or which represent a larger line of electrical apparatus and specialties, the list comprising at present the manufactures of The Okonite Co., Interior Conduit & Insulation Co., General Incandescent Arc Light Co., Standard Paint Co., Phillips Insulated Wire Co., Dick, Kerr & Co., Ltd., of London, Eng. The company is selling agent for Billings & Spencer's commutator bars, for the United States and Canada, and carries a good line of excellent specialties.

Favorable mention has already been made in these columns of Mr. Frank X. Cicott, manager of the railway department; Mr. J. E. Wilson, traveling salesman, and Mr. G. H. Buckminster, purchasing agent, all of whom are active in the interests of the company. Messrs. George E. Russell, bookkeeper and cashier, E. B. Kittle, manager of the motor department, and F. W. Ainsworth, manager of the conduit department, are also worthy of mention, both of whom are admirably qualified for their positions.

The company is managed and directed by probably the youngest men of any establishment of its kind, and its phenomenal success may be said to be thoroughly representative of what youth, ability and energy can accomplish.

The Ziegler Electric Co. may with equal pride boast of its new home. The view given is an excellent representation of the interior of the factory.

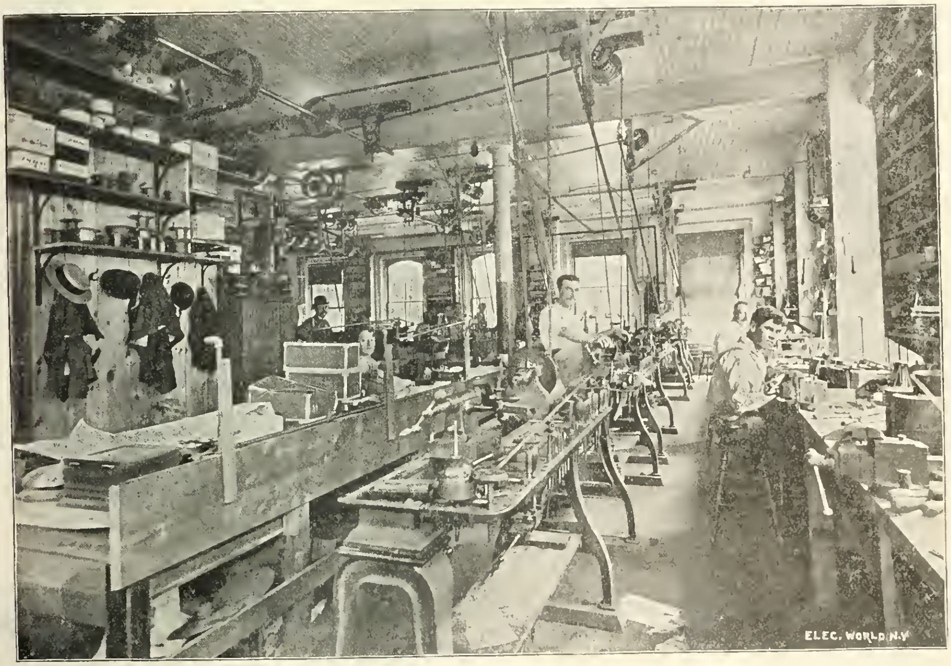
On entering the convenient and extensive office and salesroom, one observes on either hand an elaborate assortment of physical and chemical apparatus as well as electrical appliances and devices too numerous to particularize. Laboratory dynamos, batteries, frictional machines, Geissler tubes, galvanometers, magnets, microscopes, balances, tubes, pipettes, crucibles, photometers, telephone sets, and a host of other scientific and electrical apparatus may be found in abundance.

On the two sides of the block fronting Federal and Channing streets and extending also to Franklin street, are the workshops of the company. A very fine outfit of modern lathes, drill presses, milling machines and other tools, together with a forge room, enables the Zeigler Co. to undertake work of the highest grade and of extreme delicacy both for model and experimental purposes for schools and colleges, and in the development of inventions, and also in the manufacture of physical and chemical apparatus as well as electric signal, and bell apparatus and other electrical work of a delicate nature.

The combination of the well-known Gage Co., which has a wide reputation for the supply of physical apparatus for academic uses, and the Zeigler Co. is a peculiarly happy one, the latter company possessing every appliance and facility for the construction, alteration and repair of all classes of scientific instruments and testing apparatus, and for the execution of special work.

The whole premises are light and the employment of electric power (furnished by a Mather motor) is an additional convenience.

The cabinet shop of the company, for want of space in the main building, is located conveniently near and comprises a most complete wood-working plant in every respect.



A VIEW IN THE ZIEGLER ELECTRIC COMPANY'S FACTORY.

The Ziegler Electric Co. is the successor of the firm of Ziegler Bros. (Arthur and J. Oscar) both of whom have been long in the electrical business, starting for themselves May 1, 1889. Purchasing in July last the business of A. P. Gage & Son, of Boston, a decidedly valuable acquisition, they formed in August of this year the Ziegler Electric Co., under the laws of Massachusetts and with ample capital for the conduct of their large and increasing business. Mr. A. Arthur Ziegler is president and general manager of the company, Mr. A. Ziegler, of Boston, largely interested in silk manufactures, is the treasurer, and Mr. J. Oscar Ziegler is secretary and electrical engineer.

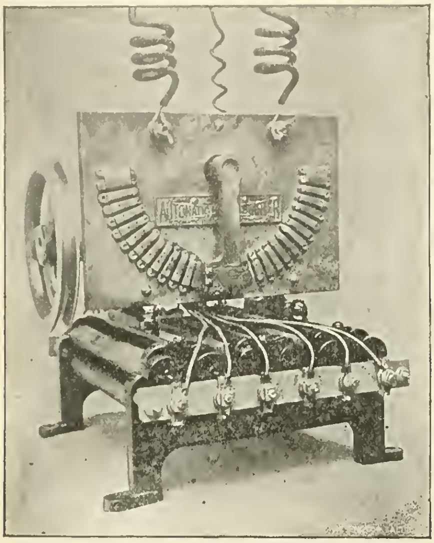
Associated with the company is the venerable father of the Messrs. Ziegler, who was at one time one of the most prominent worsted and cotton manufacturers in Switzerland, and who, although now past his 70th year of age, may be found daily at the office, hale and hearty, and active in following up the books, accounts and correspondence of the company.

Direct Electric Elevator Controller.

The accompanying photo-engraving illustrates the latest development in the line of automatic starting apparatus for electric elevators, recently brought out by the Automatic Switch Co., of Baltimore, Md. The construction is a modified form of its mechanically actuated motor starter, combined with its new fireproof tubular rheostat, which was

recently described in this journal, and embodies in one piece of apparatus all the regulating devices for the proper control of a direct electric passenger elevator

This apparatus accomplishes, without the aid of dash-pots or actuating magnets, the graduated movements necessary to start an elevator from rest to full speed, giving an even acceleration proportional to the load, and prevents entirely the possibility of starting the elevator when the load exceeds the rated capacity of the motor. The pulley of the starter is belted directly to the coupling of the elevator motor, and furnishes a positive mechanical motion to operate the switching apparatus, which is dependant upon an initial movement of the elevator itself before any of the resistance is removed from the motor circuit.



AUTOMATIC ELEVATOR CONTROLLER.

As the resistance is calculated to pass only sufficient current to start the elevator under a normal load, an excess will simply result in a refusal of the motor to start with more than it can safely carry, thus making it impossible to blow a fuse while running the elevator.

Multiple Fuse Arrester.

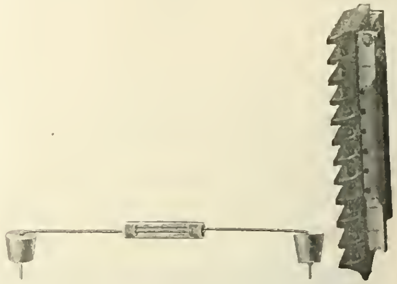
If all circuits were purely metallic, and the insulation to ground could be maintained well into the megohms, lightning protection would be a comparatively simple task, for there would then be no tendency toward arcing of the generator current at the discharge gap, but whenever the discharge gap of any arrester, connected to one side of an electric circuit and having a "ground" on the other pole, is operated upon by a static discharge, the discharge points are always more or less injured by the consequent arcing of the generator current, and at each successive discharge the points are thus rendered less sensitive to the passage of the next discharge. This is particularly true of arresters on single trolley railway circuits, where one side of the circuit is always grounded; and not infrequently a so-called automatic arrester is entirely destroyed by arcing.

In view of this difficulty attending the preservation of the discharge points of any arrester with a small air gap (and arresters must have small gaps to protect the finely wound coils of measuring instruments, as well as armatures and field coils), a succession of very sensitive discharge points, one for each discharge, can evidently be made more efficient and reliable for a given number of discharges than any one pair of points could be.

The Ajax arrester, illustrated herewith, is of the latter type, and consists chiefly of a porcelain arrester box, with a fibrone cover containing eleven fuse discharges.

The fuse, Fig. 1, consists of two pieces of No. 36 brass wire, each about three inches long, having a single silk insulation and laid side by side for about one inch, in the same manner as consecutive coils in an armature. This one inch lap of the wires offers abundant surface for the discharge gap, which is formed by the two thicknesses of silk, and amounts to little more than .002 of an inch. Small pellets of a highly insulating wax secure these wires in the above position, and a small glass tube is hermetically sealed over this part of the fuse to keep the dischargers clean and dry until used. The extreme sensitiveness of this part of the apparatus is made possible by its being called upon to act but once. The soft rubber plugs serve to hold the fuse in the corrugated cover of the arrester, and the bare ends of the wire project through the cover, ready to be brought into contact with the line and ground terminals.

Into the back of the cover are pressed two strips of metal; one a plain flat strip, to which is connected, by a long clamp, one end of each fuse; the other strip is U-shaped, and into it the remaining ends of the fuses project, but do not make contact with it, except as the carbon ball completes the connection.



FIGS. 1 AND 2.—FUSE OF LIGHTNING ARRESTER AND CONTACT GROOVE.

In Fig. 2, the carbon ball is shown making contact between the top fuse and the U-shaped strip, which, when the cover is inserted in the porcelain back of the arrester, will receive metallic connection with the line terminal through the flat spring provided for that purpose in the channel at the right in the porcelain. A similar spring is in the left channel to connect the flat strip in the cover to the ground terminal. The line and ground terminals and flat contact springs in the porcelain backs are well-illustrated in Fig. 3.

With the arrester thus assembled, it will be seen that only the top fuse has connection with the line terminal, and consequently is the only one that can be operated upon by a lightning discharge. The fuse may, or may not, be destroyed, depending upon the severity of the discharge and the condition of the line. If the line has a high potential and ground return, such as used on single trolley railway circuits, the static discharge will short-circuit the generator current at the discharge points and the fuse will be completely vaporized by the current following the discharge, which will permit the carbon ball to fall to the next fuse, bringing it into circuit automatically, ready to receive a second discharge.

If a low potential metallic circuit is thus protected, one fuse may take care of several discharges, providing the circuit is perfectly free from grounds.

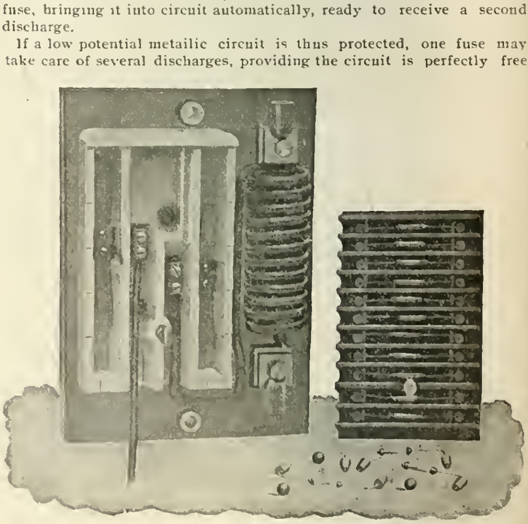


FIG. 3.—AJAX LIGHTNING ARRESTER.

If an accidental ground exists at the time of the discharge, the action will be the same as in the case of the railway circuit with the ground return. Or, if only a partial ground should exist at such time, the destruction of the fuse might not be complete; but the relative conductivity of the contact between the carbon ball and the small brass wire, as compared with the rest of the fuse, is so inferior in the former that the end of the end of the wire supporting the ball is always the first to disappear, and is sure to allow the ball to drop and reset the arrester, even though the fuse should be only partially destroyed.

The standard types of arrester are adapted to all currents, up to 1,000 volts, whether having metallic or ground return circuits, but for higher potentials fuses with a slightly wider gap should be used. Havin

reduced, as far as possible, the resistance and impedance in the arrester and its ground connection, another important step toward the protection of the electrical apparatus will be accomplished by inserting a choke coil in the main circuit, so as to divert the lightning from it into the lightning arrester, and thence to the ground. For this purpose, the Ajax arrester is furnished with coils of various capacities to suit the carrying capacity of almost any circuit upon which it may be placed.

For station use, the coil is necessarily of large dimensions, and is usually placed at the back of the switchboard. The arrester may be placed on the front of the board, and the connecting wires led through it, or it may be put in any other place convenient for inspection. The dimensions of the arrester alone are 7 inches by 4½ inches by 2¼ inches.

The type of arrester used for protecting stationary motors, or isolated plants, is shown in Fig. 3. The regular size is made with a 100 ampere coil, having coil and arrester mounted on a marble slab 7¾ inches by 11 inches by ⅞ inch. For electric cars or pole line use, the arrester is placed in an asbestos lined iron box, to protect it from the weather or external injury. The number of arresters required to protect any plant against lightning, must be determined by local conditions, such as the frequency and severity of thunder storms, the amount of natural protection afforded the line by adjacent objects, and the nature of the line itself.

Electric Railway Joints and Bonds.

We illustrate herewith two forms of rail joints and bonds known as the K-joint and Little Giant Joint, both manufactured by the Price Railway Appliance Company, 125 South Fifth street, Philadelphia.

Fig. 1 shows the K-joint, with its bonds, an edgewise view of the joint plate being given in Fig. 2 and of the brace chair in Fig. 3. Each joint

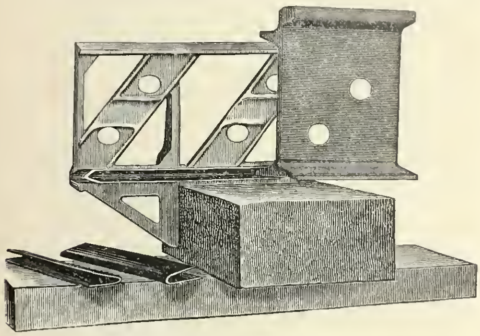
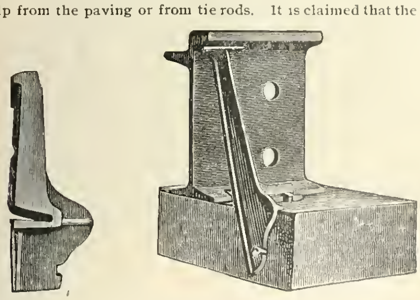


FIG. 1.—K-JOINT WITH ITS BONDS.

consists of a powerful jaw, Figs. 1 and 3, embracing the flange of two rails; of a foot, rectangular in shape, forward of the jaw and spiked both to the top and side of the tie; and of a series of diagonal braces, assuring great strength to the joint-plate, and of a framework of ribs, with these carrying the top of the plate, and its inward ledge to maintain alignment. The brace chairs, for use outside of the rails, hold the rail erect without any help from the paving or from tie rods. It is claimed that the K-joint



FIGS. 2 AND 3.—EDGWISE VIEW OF K-JOINT PLATE, AND BRACE CHAIR.

exactly doubles the customary bearing on the ties, and prevents knocking at the joints for the reason that the rails are held as in a vise, with their heads fully supported. As wear comes on the rail the heads of the joint press inwards through the leverage from the feet of the joint, and maintain their tightness. The under side of the jaw comes so far under the rails as to render the use of a tie-plate superfluous. The K-joint is made of malleable iron and is driven up with a sledge, assuring solid construction and permanent pressure. In a plate made by Prof. A. J. Rowland, of the Drexel Institute, it was found that with a mean current of 195 amperes the loss in the joint, without copper bonds, was only 1.67 watts, and of the whole piece 1.86 watts—less than 1-500 h.p. Fig. 4 shows the Little Giant joint, and Fig. 5 is a view of the same with its bond. Like the K-joint, it has great strength with but a moderate use of metal, and in a similar manner embraces the flanges of the two rails, where they come together, within a vise-like jaw attached to a supporting truss below, suspended from the feet of the joint-plates seated upon the ties. From this jaw arises a vertical plate the top of which supports the heads

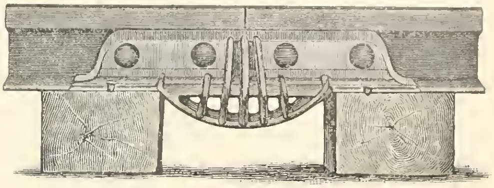


FIG. 4.—LITTLE GIANT JOINT.

of the rails at the joint, with an inner edge to secure alignment. Ribs springing from this joint encircle the jaw and attach themselves to the upper surface of the arc of the truss. It is claimed that the joint will not open under the weight of the heaviest locomotive, and that it has double the strength, elasticity and endurance of other joints of the same weight.

The bond for both of these joints consists of a plate of copper bent into a V-shape, which is placed upon the flanges of the two rails on each side and enclosed within the jaws of the joint when drawn up. As the jaw has the effect of a double inclined plane, it firmly compresses and holds the copper when spiked and bolted, thus furnishing a large surface and efficient contact, and one not exposed to electrolysis.

In a competitive test of five rail-bonds made by Prof. A. J. Rowland,

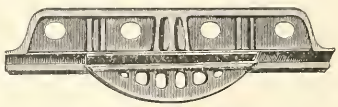
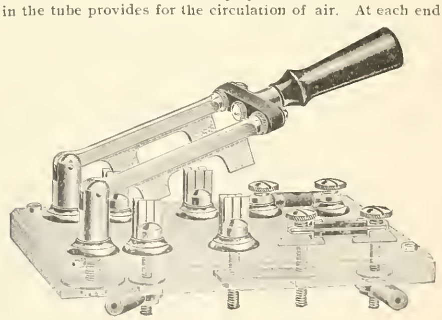


FIG. 5.—INTERIOR OF LITTLE GIANT JOINT WITH ITS BOND.

of the Drexel Institute, the loss per mile with a current of 200 amperes with this bond was 301 watts, while the loss with the four competing bonds under the same conditions was 331, 418, 842 and 1,000 watts, respectively.

Improved Knife-Blade Switch.

The accompanying cut represents a double pole single throw switch mounted with fuse cut-outs on the same base. The manufacturers, the Electrical Engineering & Supply Co., Syracuse, N. Y., has added to the neat appearance of the switch by making all terminal connections on the back of the base, thus leaving out of sight the usual clumsy looking connections. It will be noted that the fuses are respectively surrounded by hard rubber tubes, one of which is shown in section, which device protects the finish of the base from injury in case a fuse blows. A small hole in the tube provides for the circulation of air. At each end of the



NEW KNIFE BLADE SWITCH.

hard rubber tube is fitted a metal cup and a tube in one piece, extending externally from the hard rubber tube. The bore of the metal tube is slightly greater than the diameter of the fuse wire, and is sawed so that the fuse wire and holder complete rests in the socket of the base terminals, the knurled screw clamping firmly together fuse wire, brass tubes and base terminal. This switch is especially designed for switchboard work where economy of space is desirable, as the terminals do not require more than half the space of an ordinary switch, thus making it much neater in appearance and facilitating the back connections to quite a degree.

Financial Intelligence.

The Electrical Stock Market.

New York, Sept. 8, 1894.

GENERAL ELECTRIC, by reason of its prominent position in the trade, must always be treated of first in recounting the share electrical stocks take in stock market transactions. The result of the week's trading has but fractionally affected quotations; nevertheless, decided strength has marked the dealings in General Electric. All reports relative to its business show that it is steadily increasing in both new construction and replacement work. At the Lynn works there are now about 1,500 hands employed for full day's labor and on the same basis over 3,100 hands are at work in the Schenectady shops. This shows a payroll of slow but steady increase. Unfilled orders are understood to amount to more than $2,500,000 worth. Among other things it is preparing to equip another Chicago elevated road, the Lake Street system, with electric motive power, undertaking to furnish an equipment that will save the railroad company $6,000 a month in operating expenses.

WESTERN UNION TELEGRAPH has really been one of the star features of the stock market. The movement in the stock is admittedly a speculative one, such active operators as S. V. White and Kennett, Hopkins & Co. being most conspicuous in the trading. It has all along been known that a short interest has existed in the stock, and this is being driven to cover with corresponding loss. There are about 1,000,000 shares of stock outstanding; of this amount there are only some 80,000 or 90,000 shares in Wall street. The rest of the stock is well distributed among 75,000 shareholders in America and Europe, so that the supply available for speculative purposes is exceedingly limited. It is therefore a very easy thing to boom Western Union under ordinary circumstances, and it could be carried to par without meeting much stock on the way up. Officials of the company say that the rise is on a substantial basis. The present quarter and the succeeding one are the two best quarters of the year, and earnings are very satisfactory. The dividend to be declared on Wednesday of next week has been earned, and there will be a substantial surplus left over as a result of the quarter's operations.

BELL TELEPHONE stock still rules above 200, with but little interest taken in its fluctuations. There has been nothing new developed relative to the placing of the $30,000,000 new capital stock authorized by the Massachusetts Legislature to be sold at public auction.

INTERIOR CONDUIT AND INSULATION COMPANY'S ruling stock prices are about ten points lower than what they were a week ago, though the stock is held so largely by the officials of the company that market quotations rather reduce the stock's rating below the normal value. The company reports the largest tube business for August since its organization, its sales amounting to over 1,000,000 feet. This tubing was for interior work only, but the company is now making preparations to manufacture underground tubing on a large scale, and expects in a month from now to make an exhibit of its specialties in tubing and other manufactures.

THE COMMERCIAL CABLE COMPANY has declared its regular quarterly dividend of 1¾ per cent., payable October 1. Transfer books close September 20 and re-open October 2.

IN CONSEQUENCE of the regular payment, September 1, of interest on the Edison Electric Illuminating Company's bonds, quotations are a trifle lower.

STREET RAILWAY AND ILLUMINATING PROPERTIES: A correspondent calls our attention to several statements that appeared in this column in our issue of September 1, relative to the Street Railway and Illuminating Properties, in which he states there are some errors. Referring to the statement relative to the source from which is received the money required for the cancellation of preferred stock, namely, "This makes a total of 14,682 shares cancelled since the 'trust' was formed last year, all the money being derived from dividends and interest payments on the stocks and bonds incorporated, or rather deposited in it," he says that, by the terms of the declaration of trust, income and principal are to be kept entirely separate. The income from the various securities, derived as dividends, interest upon bonds and notes, and revenue from plants, etc., is to be applied first to the payment of the expenses of managing the trust, and second, to payment of dividends on the preferred stock at the rate of 6 per cent. per annum. Dividends were paid February 1 and August 1, 1894. The revenue derived from the *sale* of the securities is applied first to the retirement of the preferred stock, and it is from this source—that is, cash derived from the *disposal of the stock and bonds, etc.*, incorporated in the trust—that the 14,682 shares (now 15,344 shares) have been purchased and cancelled. By the purchase of 662 shares at an average price of 99.58 on the 30th ult., the outstanding preferred stock is reduced to 29,656 shares. Referring to another statement to the effect that "it will only take 15 months before the whole issue is retired, which will make the $4,500,000 of common stock the sole owners of the $12,000,000 stocks and bonds acquired from the General Electric last year for $4,250,000," we are informed that the assumption that the stock will be retired at the rate of 2,000 shares a month is not a correct one, as the amount of shares that it is possible for the trustees to cancel depends entirely upon the sale of the various securities held by them. This involves consideraton, of the condition of the stock and bond market, general business conditions and a thousand and one things which will render the retirement of the stock irregular. The statement that there is $4,500,000 common stock is also referred to as erroneous, since the common stock has no stated par value. There were issued 45,000 shares of preferred stock, having a par value of $100 each, and 45,000 shares of common stock, the value of which is not fixed. After the retirement of the 45,000 ($4,500,000) shares of preferred stock the remainder of the securities in the hands of the trustees belong to the holders of the 45,000 shares of common stock, and the proceeds of their sale will be divided equally among these stockholders, which makes the value per share of the common stock entirely a matter for future determination. Finally, the General Electric Company received for the 45,000 shares of preferred stock (the common stock being carried with it as a bonus) the sum of $4,050,000, being par less 10 per cent. for underwriting.

ELECTRICAL STOCKS.

Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	104	105½
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¾	3
General Electric	100	40½	40¾
General Electric pref		70	75
Interior Conduit & Ins. Co.	100	35	45
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35½	36½
" " pref	50	53	53¼

BONDS.

*Edison Electric Ill., New York	1,000	107½	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	201	202
American District Telegraph	100	42	49
American Telegraph & Cable	100	90	91½
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	145
Erie Telephone	—	48¼	50
Gold & Stock Telegraph	100	100	103
Mexican Telegraph	100	185	200
New England Telephone	—	68	69
Western Union Telegraph	100	90½	90¾

* Ex-div.

New Incorporations.

THE NICHOLSON LIGHT, HEAT AND POWER COMPANY, Nicholson, Pa., capital stock $7,000, has been formed.

THE UNITED TELEGRAPH, TELEPHONE AND ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000, has been incorporated. D. McDonald, J. G. Earle and E. P. McConnell are interested.

THE CALDWELL ELECTRIC LIGHT AND WATER COMPANY, Caldwell, O., capital stock $10,000, has been formed. T. D. Carmack, A. Young, W. Butler, C. McFerren and D. M. McFerren are the incorporators.

THE JACKSONVILLE ELECTRIC AND POWER COMPANY, Jacksonville, Ill., capital stock $100,000, has been formed to furnish electric light and power, etc. G. B. Stafford, S. H. Trude and W. H. Lee are the organizers.

THE CITIZENS' ELECTRIC COMPANY, Middleton, O., capital stock $20,000, has been formed to furnish light, heat and power. T. Cooper, W. H. Drayer, W. Martindale, R. B. Edson and J. C. Russell are interested.

THE HOME SWEET HOME IMPROVEMENT COMPANY, Billings, Mon., capital stock $50,000, has been incorporated by M. D. Jeffers and others. One of the objects of the company is the building of electric street railways

THE CITIZENS' TELEPHONE AND TELEGRAPH COMPANY, Hagerstown, Md., capital stock $25,000 has been incorporated by J. W. Emmert, W. H. Armstrong, C. W. Sebold and P. W. Avirett, to operate telephone and telegraph lines.

THE ACME ELECTRIC LIGHT AND POWER COMPANY, North East, Pa., capital stock $15,000, has been formed to manufacture and supply light, heat and power. B. E. Hillman, J. A. Stetson and W. D. Wells, all of North East, are interested.

THE CANTON LIGHT, WATER AND POWER COMPANY, Canton, O., capital stock $50,000, has been formed to supply electricity for street lighting. W. A. Lynch, C. R. Miller, A. J. Underhill, L. C. Foltz and H. M. Lyman are the promoters.

THE RIVERSIDE ELECTRIC RAILWAY COMPANY, Riverside, Pa., capital stock $50,000, has been formed to construct, maintain and operate a street railway. J. Q. Denney, W. B. Hammond, Harrisburg, and E. C. Felton, Steelton, Pa., are interested.

THE MANCHESTER STOVE COMPANY Manchester, O., capital stock $15,000, has been formed to furnish power for electric lighting, also stoves, castings, etc. G. H. Halliday, N. Patton, J. W. Jones, H. Collings and J. A. Shrin are interested.

THE ELECTRIC CONSTRUCTION COMPANY, Cleveland, O., capital stock $10,000, has been formed to deal in apparatus for electric lighting and railway plants. E. H. Fishack, T. J. Carmack, H. F. Fishack, M. J. Carmack and R. McNaull are interested.

THE OHIO STORAGE BATTERY COMPANY, Cleveland, O., capital stock $1,000, has been formed to deal in electrical devices of all kinds, including storage batteries. W. C. Bunts, C. A. Cook, G. S. Kain, W. H. Bearis and F. M. Mather are interested.

THE SANATOGA, ROYERSFORD AND COLLEGEVILLE ELECTRIC RAILWAY COMPANY, Philadelphia, Pa., capital stock $150,000, has been formed to construct and maintain an electric street railway. P. W. Smith, C. Dillenbeck, Philadelphia, and J. C. Lynch, Royersford, Pa., are the organizers.

THE CHARLEROI, CALIFORNIA AND BROWNESVILLE ELECTRIC RAILWAY COMPANY, Charleroi, Pa., capital stock $70,000, has been formed to construct, maintain and operate an electric railway. A. C. McKean, Charleroi, J. W. Crawford, Duquesne, and W. J. Berryman, Washington, Pa. are interested

THE FARMERS' TELEPHONE COMPANY, Massillon, O., capital stock $10,000, has been formed. This company will build and operate telephone lines through nearly every county in Ohio. M. S. Card, N. F. Moffatt, J. H. Fisher, W. Max Hiem, A. J. Gordon, F. Z. Groff, R. A. Pinn and A. Short are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Sept. 8,, 1894.

MR. S. F. HOLMES has removed his office to the Downing building, 108 Fulton street.

C. D. BERNSEE, New York agent for the Eco magnet watchman's clock, reports business exceedingly good, having recently made several large sales.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, selling agents for the Fleming woven wire dynamo brushes, report sales steadily increasing. Orders are coming in from all parts of the country.

THE PITTSBURG REDUCTION COMPANY, manufacturer of aluminum, has opened a New York office in the Havemeyer building, corner of Church and Dey streets, with James C. McGuire in charge. The company will carry a large stock of aluminum in this office.

CHARLES E. CHAPIN, electrical supply dealer, 136 Liberty street, reports business improving, having recently sold to a leading construction house a quantity of oak mouldings for wiring purposes, which in length would reach from the Battery to Forty-second street depot.

MR. MAURICE J. LUNN, of the Miller Manufacturing Company, Ltd., of Pittsburg, Pa., manufacturers of combination gas and electric thimbles, is in the city and was a caller at The Electrical World offices last week. Mr. Lunn is here in the interest of his thimble, and has succeeded in having it pass the Board of Underwriters in this city. The thimble is something new, and will no doubt meet with great favor.

THE NATIONAL CONDUIT MANUFACTURING COMPANY, Times Building, New York, has been awarded a contract for the complete work for the West End Street Railway Company's subway system. This contract is a very large one and the National Conduit Manufacturing Company feels much pleased over this, as they were brought in direct competition with every style of conduit system in use to-day.

CANADIAN NOTES.

OTTAWA, Sept. 5.

AYLMER, QUE.—Conroy Bros., of Deschenes, have offered to put electric lights in the town for public and private use, which it is understood will be accepted.

MONTREAL.—For the Holmes Electrical Protection appliances introduced in buildings upon which they hold risks the Board of Underwriters allow a rebate of 10 per cent. upon all premiums.

GUELPH, ONT.—An arrangement has been made between the City Council and George Sleeman for the construction of an electric street railway. The first section is to be completed by April 1, 1895.

MONTREAL.—The Electric Railway has been opened from the Island of Montreal, giving direct communication with the city to the outlying municipalities of Outremont, Cote des Neiges and Notre Dame de Graes.

PERTH, ONT.—A public meeting was held recently to discuss the advisability of granting a bonus to an electric railway from Perth to Lanark. Two routes were proposed. The scheme is favorably entertained.

MONTREAL.—The earnings of the Montreal Street Railway Company still compare favorably with the earnings a year ago. During the week ending August 4 the total earnings was $19,399, as against $17,917 for the corresponding week of 1893.

GALT, ONT.—The entire electrical equipment, including rolling stock of the Galt and Preston Electric Railway, was furnished by Ahearn & Soper, of Ottawa, and is one of the most complete in Canada, having all the latest improvements electrical science can compound. The engines, etc., are from Goldie, McCulloch & Co.

PETROLIA, ONT.—Application has been made by the Petrolia Electric Light Heat & Power Company for incorporation, to construct and operate works for the production, sale, and distribution of electricity. The operations of the company are to be carried on in the town of Petrolia and in the County of Lambton. The capital stock of the Company is $25,000.

HULL, QUE.—The promoters of the scheme for constructing an electric street railroad in this city are making satisfactory headway. The electric lighting plant will be formed first, as this part of the franchise is considered to be the most valuable. During the coming Winter ties will be procured for the electric road which will be laid in Hull next Summer. The promoters will extend the lines to Aylmer, whence a great deal of Summer travel is directed toward Ottawa.

QUEBEC.—Official notice is given that Hon. Louis Tourville and Messrs. Fred. Thompson, G. F. Burnette, of Montreal; Andrew Haddy, of Longueil; W. B. Powell, of St. Lambert; Henry Williams and Joseph Horsfall, of the same place, ask to be incorporated as the South Shore Electric Company, with a capital of $25,000, to erect works for the production of electricity for lighting, heating and motive purposes, to operate electric railways in the counties of Vercheres, Chambly and Laprairie, and to construct and operate water works in the said counties.

OTTAWA, ONT.—The Controller of Inland Revenue has commenced the work of organizing a bureau of electric light inspection under authority of the act passed last session. Hon. Mr. Wood is in communication with Prof. London, of Toronto University, in regard to the equipment requisite for the work of inspection. Beyond an expert, whose duty it will be to instruct the inspectors, no new appointments to the outside staff of the department will be necessary in order to carry on the work of inspection, the intention of the controller being that the inspection of electric lighting shall be performed by the gas inspectors now in office. Mr. Wood believes that once an operation of the testing apparatus has been explained to them the inspectors will have no more difficulty in testing the electric lights than they encounter in the inspection of gas.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, England, Sept. 1, 1894.

AN ELECTRIC TRAMWAY IN THE ISLE OF MAN.—An electric tramway some seven miles long between Douglas and Lascey, in the Isle of Man, has been opened. The only point about it of any novelty is the use of a fixed accumulator station feeding the centre of the line.

THE NEW TARIFF.—Except in the event of a corner in bi chromate of potassium, which, in commercial phenomena is scarcely likely to occur, the new tariff imposed by the United States does not appear to be likely to have any very serious effect on British electrical industries.

THE IMPERIAL OHM.—By an order in Council, her Majesty the Queen, has legalized the standard ohm volt and ampere as Imperial British measures. These units have for some time been legalized in America by Congress, but not until the present time have they had legal recognition in this country..

THE ELECTRICAL MANUFACTURING INDUSTRY.—Although there is nothing in this country corresponding to the intense depreciation reported to be ruling in the States, the electrical manufacturing industry is making none too much profit. Thus a few days ago the well known firm of Crompton Company, Ld., which most people were under the impression was doing a good business, had to confess to it shareholders that the operations for the past year did not enable it to pay a good dividend.

ELECTRIC LIGHTING IN THE CITY.—The City of London Electric Lighting Company furnish the following return for the quarter ending June 30 last, which return shows in a striking manner the progress of electric lighting within the city of London. The total amount received for current sales for the quarter ending June 30, last, amounted to £10,315, as against £5,913 for the corresponding period of last year. The equivalent of 8 c. p. lamps connected on June 30 this year was 99,140, as against 45,562 last year.

WOODHOUSE & RAWSON UNITED.—The inquiry into the failure of this well-known electrical engineering firm, which has occupied the Bankruptcy Court during some twelve sittings, extending over seven weeks, terminated on Wednesday last. It is impossible to say as yet what the next step will be, but so far as one can see, it is not likely that there will be any very definite result, though it is very evident that the history of the concern, from its foundation to its liquidation, has been a strange medley of muddle, mismanagement and extraordinary sanguineness.

SEARCH LIGHTS.—The recent naval manœuvres have, as usual, afforded some side lights on how not to use the search light, though the lesson has this year been an extremely pointed one. When one of the fleets was at anchor in Belfast Lough during the night, something like panic prevailed owing to a series of false alarms that a torpedo boat attack was imminent; the whole fleet kept on flashing forth the rays of the search light, and amidst the alternations of darkness and bright light the best eyes became dazed. Some of our unemployed electricians would perform a beneficial service in devoting their enforced leisure to the solution of this question.

THE LIVERPOOL AND CITY & SOUTH LONDON RAILWAYS.—The following comparative figures with regard to the performances of these two lines may be of interest; they certainly seem to point towards the advantage of using motor cars as against locomotives. During the half year ending June 30, last, the Liverpool line carried 2,861,000 passengers, and the City & South London 3,383,000; the train miles run being respectively 265,000 and 227,000. In the case of the Liverpool line, the passenger receipts per train mile were 17¾d., and that of the City & South London line 24¼d., the locomotive expenses per mile being respectively 2¾d. and 5¾d.

ELECTRIC POWER TRANSMISSION IN THE TRANSVAAL.—Whatever the Niagara scheme may or may not do, it cannot be gainsaid that it has stirred up many others to go and do likewise. The last African mail brings full details of an electric power transmission concession granted to an English electrical engineer by the Transvaal government. Permission has been granted to canalize the Vaal River, and transmit the power thence to the Randt at Pretoria, where it will be made use of to drive stamps and supply power to the mining companies there at work. It is estimated by competent authorities that during the dry season 20,000 h. p. will be available.

MUNICIPAL ELECTRIC LIGHTING.—The Hanley Municipal Electric Lighting Station was opened recently, the work having been carried out by the Brush Company. Although the Glasgow Municipal Works did not show a profit for the year 1893-94 their record is a fairly satisfactory one. If we include interest on loans, sinking fund, and a sum of £4,393 set aside for depreciation, there is a loss of £607. Had there been no sinking fund set aside, and had the depreciation account been treated in the manner that most electric light companies treat it, this loss of £607 would have been converted into a profit of some £4,000. There seems to be a several leakage going on in the supply system, since of the total number of units generated at the works rather more than 16¼ per cent. are unaccounted for.

MUNICIPAL PURCHASE OF TRAMWAYS.—The House of Lords gave on Monday a momentous decision relating to the municipal purchase of tramways. By the forty-third clause of the Tramways Act of 1870, it was laid down that after twenty-one years the local authority should have power to purchase the local tramways "upon terms of paying the then value (exclusive of any allowance for past or future profits of the undertaking or any compensation for compulsory sale or other considerations whatsoever)." This, one would think, was plain enough, but, nevertheless, the first two tramway concerns to come under the operation of the act, viz.: the Edinburgh Street Tramways Company and the London Street Tramways Company, thought otherwise, and carried the matter from the court of first instance right away up to the House of Lords, with the result that that tribunal has finally decided that all a tramway company is entitled to upon a municipality proceeding to purchase under the terms of the Tramways Act, is a sum equal to the cost of establishing a similar line in a similar condition, a sum which, it is unnecessary to say, is in all cases considerably less than the actual capital expenditure of the company. There can be little doubt that this decision will have, at any rate, a temporarily detrimental effect on the progress of electric traction in this country. The extension of tramways is also likely to be arrested, since each concern will now have to satisfy intending shareholders that it will be able to pay them a normal rate of interest, and at the same time lay by a sufficient sum to partially re-

place capital at the end of twenty-one years. The cessat' n of t amway enterprise, however, is not likely to be of long standing, for either the municipal purchase clause will be amended, or municipalities will obtai i powers not only to purchase, but to work existing lines and to construct new lines.

News of the Week.

TELEGRAPH AND TELEPHONE.

MAYSVILLE, KY.—Fitzgerald & Limerick will construct a telephone system.

MT. AIRY, N. C. The Southern Telephone Company, of Fayetteville, N. C., is building a telephone line from Mt. Airy to Dobson, and a telephone exchange at the former place.

COLUMBIA, MO. Messrs. Truitt and Fyfer have been granted a twenty-year franchise by the City Council to erect and maintain a telephone system. Work will be begun at once.

YOUNGSTOWN, O.—The Mahoning Electric Light Company of Youngston, O., has renewed its contract for street lighting for a period of seven years. The contract calls for about one hundred additional lights, part of which are to replace four hundred vapor lights; and it will require the company to make some changes and additions in its equipment to provide for the increase. It has in use both T. H. and Wood dynamos, and now proposes to enlarge the units and reduce them to one manufacture. The system to be used is not yet settled upon.

ELECTRIC LIGHT AND POWER.

NECEDAH, WIS.—A movement is on foot to establish an electric plant.

JACKSON, TENN.—Address the mayor concerning electric lighting contract to let.

OAKESDALE, WASH.—The village has voted to issue $23,000 Light and Water bonds.

NEOSHO, MO.—V. H. Vogle has made the city a proposition to supply electric lights.

OXFORD, MISS.—The matter of putting in an electric light plant is being considered.

GALLATAN, TENN.—The council has granted a franchise for an electric light plant.

CARTHAGE, O.—The citizens will vote on the question of issuing $15,000 water and light bonds.

LISBON, IOWA.—Plans and specifications are being prepared for a $3,000 system of electric lights. W. H. Runkle is manager.

DETROIT, MICH.—The United Presbyterian Society's new building at Alexandria and Grand River avenues will have electric lights.

ESTHERVILLE, IOWA.—The City Council has awarded the contract for putting in an electric light plant to the General Electric Company.

TOPEKA, KAS.—The board is considering the matter of placing an electric light plant in the high school. H. W. Farnsworth may be addressed.

VICKSBURG, MISS.—Address the mayor concerning contracts to be awarded on October 1 for lighting the city for five years with 75 to 100 arc lights.

MARTIN'S FERRY, O.—An election will be held September 22, to vote on the proposition to issue $30,000 in bonds to construct an electric light plant.

RICHMOND, IND.—The new Commercial Club building will have electric lights. The architects are Oscar Cobb & Son, 1510 Manhattan Building, Chicago.

CHICAGO, ILL.—The County Board has decided to advertise for bids for the new court-house, to be received until September 26, an electric plant being comprised.

NEW ORLEANS, LA.—The matter is under consideration of putting an electric light plant into the government mint. R. L. Schroder may be addressed.

ST. CHARLES, MO.—A special election will be held here to decide whether or not a franchise for an incandescent electric light plant shall be granted to Messrs. William and McGee.

CUTHBERT, GA.—The election to determine whether or not Cuthbert shall have a system of electric lights resulted in a vote in favor of the improvements being made. Work will be begun at once.

KANSAS CITY, KAS.—The Consolidated Electric Light & Power Company is unable to furnish sufficient light. It is probable that the council will pass an ordinance to increase the capaci y of the plant.

NORTH TONAWANDA, N. Y.—Work has been started on excavations at the rear of the Smith Block, Tremont street, for the erection of a lighting and heating plant by the firm of Armitage, Herschell & Co.

CHAGRIN FALLS, O.—A company has been formed and arrangements completed for giving Chagrin Falls electric lights. It is expected that the streets will be lighted by electricity before the first of October.

HAMILTON, N. Y.—There is a movement on foot for establishing an electric light plant in connection with the water-works, which is now being built, in this place. A special meeting will undoubtedly be called to decide the matter.

BEL AIR, MD. The Bel Air Electric Company desires to receive catalogues and prices for wire, meters, transformers, lamps and brackets to equip its new plant, which is about ready to start. Address Henry Reckord Manufacturing Company, Bel Air, Md.

SING SING, N. Y.—Thomas McCormick has secured the contract for the electric light building on the Upper Docks, to be used as the power house for the Sing Sing Electric Light Company, and has commenced work on it. It is to o f brick, two stories high. There will be room for fourdynamos at first

HEALDSBURG, CAL.—A large cream of tartar plant is being erected by George de Latour. There will be six buildings in all, and the plant will be in operation in November. An electric plant will be put in if satisfactory arrangements can not be made with the city plant to furnish all-night service.

MIDDLETOWN, CONN.—As the result of the special town meeting, at which it was voted to establish electric lights at Newfield, South Farms and Westfield, an injunction has been issued restraining the selectmen from taking any action in the matter until after another special town meeting has been called to rescind the former vote.

CLEVELAND, O.—Councilman McConville has announced that he will introduce a resolution in the Council calling for the enforcement of the underground wire ordinance. He says that the city is now placing its wires underground,and there is no reason why private corporations should not be compelled to live up to the terms of the ordinance.

MIDDLETOWN, O.—A new electric light company has been organized, of which Thomas Cooper, of Columbus, O., will be at the head. The company will do business as the Citizens' Electric Light Company. The incorporators are William Martindale, W H. Drayer, Hos. C. Russell, R. B. Edson and Thomas Cooper. The capital stock is $20,000.

LITTLE ROCK, ARK.—On August 2 the dynamos of the municipal plant were so seriously damaged by suphuric acid thrown on them by a discharged electrician that they will require three weeks for repairs. The armatures and fields are being removed by the Brown Electric & Machinery Company, and in the meantime the streets are being lighted by private lighting companies.

ROANOKE, VA.—Mr. W. Frank Carr, general manager and superintendent of the Roanoke Electric Light & Power Co., has tendered his resignation, which was acceped by the Board of Directors, to take effect Aug. 10. Mr. Carr came to Roanoke in April, 1892, from the St. Paul and Minneapolis system, where he had been engaged for a number of years as Chief Engineer. During his stay in Roanoke he has rebuilt the electric light plant, and it is to-day one of the finest in the State. He expects to return north either this fall or early spring.

WOODBURY, N. J.—Several Woodbury capitalists are considering the advisability of having a new lighting company in said city. It is understood upon good authority that a company composed of the most prominent citizens of that place has been formed, and an ordinance will shortly be presented to the City Council asking for the privilege of erecting poles and stringing wires. A site for the erection of a plant has been picked out, and should the new company be successful in having an ordinance passed in council, it will immediately commence erecting a plant. The main object of the company is to furnish the city with light.

THE ELECTRIC RAILWAY.

COLUMBUS, GA.—The Columbus Railroad Company will erect an electric power plant to operate a street railway.

MANSFIELD, O.—The work of surveying the proposed Mansfield-Shelby-Galion electric railway has been begun.

PORTAGE, WIS.—A proposition is before the citizens to establish an electric road. A. D. Moore is interested in the project.

CHICAGO, ILL.—The Lake Elevated Railway will be extended at once to Wabash avenue, and is to be equipped with electric power.

BALTIMORE, MD.—The City & Suburban Railway Company proposes to build an electric line along the Frederick road out to Cantonsville.

AMERICUS, GA.—A number of Americus people are considering the question of building an electric road to Magnolia Springs, ten miles distant.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company will construct their proposed tramway line between the towns of Bristol and Plainville.

BALTIMORE, MD.—Work will be commenced at once on the Baltimore, Middle River & Sparrow's Point Electric Road, in which Levin F. Morris is interested.

BLOOMFIELD, N. J.—The Suburban Traction Company has renewed its application for a franchise to operate the present railroad with electricity instead of horses.

FORT WAYNE, IND.—A company is being organized to build an electric road from Fort Wayne to Churubusco. Col. D. N. Foster and P. A. Randall are interested.

WESTMINSTER, MD.—It is stated that $20,000 has been pledged towards an electric road from Reisterstown to Westminster and Union Mills. J. M. Herring is interested.

LYONS, IOWA.—A franchise has been granted to the Oakland Avenue Electric Line. The capital is $50,000. E. C. Walsh is president and D. Langan secretary. Both live in Clinton.

PROVIDENCE, R. I.—General Manager Potter of the Union Railway Company, has notified Councilman J. F. Freeman that the Eddy street route will be extended to New York avenue.

CHARLOTTESVILLE, VA.—The Piedmont Construction Company has been given permission to extend its line and equip it with electric motors. J. E. Willard is the president of the company.

INDIANAPOLIS, IND.—An explosion of natural gas occurred at the main power-house of the Citizens' Street Railway Company, wrecking the house and boilers. The total loss will exceed $20,000.

WASHINGTON, D. C.—The East Washington branch of the Eckington & Soldiers' Home Electric Line has been completed. Thirty cars will be placed on it. Robert I. Todd is general superintendent.

OPELIKA, ALA.—Work has been begun on the electric road from Opelika to Auburn, and rolling stock has been ordered for it. John L. Cowan, of Opelika, is among the principal parties interested.

AMERICUS, GA.—Bascom Meyrick can give information concerning a movement to organize a company for the construction and operation of an electric road to Magnolia Springs, ten miles from Americus.

ALEXANDRIA, VA.—It is announced that work will soon be commenced on the Washington, Alexandria & Mt. Vernon electric road. The bill has been signed by the President. F A. Reed is interested.

WASHINGTON, D. C.—The Washington, Arlington and Falls Church Elec t ic Railway Company is removing the underbrush from the surveyed line of road from Arlington by way of Balliston to Falls Church.

CORTLAND, N. Y.—The application of the Cortland & Homer Railroad Company to use electric motive power on its present lines and those to be constructed, wi be considered by the State Railroad Commission.

THE LANCASTER RAILWAY CONSTRUCTION COMPANY, Lancaster, Pa., has a contract for building forty-three miles of electric railway in Lancaster, to be finished before January 1, instead of twenty-three, as recently stated in these columns.

NEW HAVEN, CONN.—An electric road connecting East Haven and Branford will be the next move in local electric road circles. The New Haven Street Railway Company asked the last legislature to give it the right of way from this city to Branford.

SOUTH BEND, IND.—J.McM. Smith, of the General Power & Quick Transit Company, of this city, has been granted a franchise to build an electric railway connecting Mishawaka and South Bend. Work will be commenced at once and the road be in operation next spring.

NEW YORK CITY, N. Y.—The Forty-second Street, Manhattanville and St Nicholas Avenue Railway Company has applied to the Board of Aldermen for a franchise to lay a double track for a street car line on West Eighty-sixth street, from Eighth to Tenth avenues.

BRIDGEPORT CONN.—The Traction Company will extend its line through Congress and Pequonnock streets to Jones avenue, thence to Oak street to North avenue. The Park avenue extension will probably be from Fairfield avenue to North avenue and thence to Mountain Grove Cemetery.

MALDEN, MASS.—At a special meeting of the Malden Aldermen there was a hearing on the petition of the Malden, Melrose & Stoneham Street Railway Company for a location on Highland avenue, from the Medford line to the latter point, with the West End road to Boston. The matter was taken under advisement.

CHICAGO, ILL.—The Secretary of State has licensed a new street railway incorporation for Chicago. It is to be known as the Suburban Rapid Transit Company, capital stock $1,000,000, to build and operate a road from the western limits of the city, between Twenty-second and Thirty-first streets to the village of Hinsdale.

CARTHAGE, MO.—E. J. Spencer, of St. Louis, the electric railway promoter, met with a number of the Commercial Club members and outlined a proposition upon which he will build an electric road from Carthage to Webb City. Messrs. J. E. Lang, J. W. Halliburton and A. L. Thomas were appointed a committee to see what amount could be raised for the enterprise.

TOLEDO, O.—Bids will be received until September 8 for the excavating, grading, etc., necessary to complete the road between Toledo and Maumee, and for white oak or cedar ties, rails, angle bars and bolts for the same; railroad spikes, switches, 2,000 No. 2-0 bonding wires, 30 inches long, and 20,000 pounds of 2-0 trolley wires. Address Toledo & Maumee Valley Railroad Comdany.

TACONY, PA.—The plans of the Holmesburg, Tacony and Frankford Electric Railway to lay tracks on Church street from Tacony to Franklin, were approved of by the Board of Surveyors. The consent has also been secured by the Lombard and South street line to lay double tracks to Cobb's Creek. The Philadelphia Traction Company also claims the right to lay double tracks on the avenue.

SIDNEY, N. Y.—The party of engineers who are surveying the proposed electric railroad from Sidney to Morris, consists of five men, and is in charge of E. F. Musson, of Norwich. The survey from Cope's Corners to Morris, a distance of eight miles, is completed, and the surveyors have started to survey from Cope's Corners to Sidney, a distance of about ten miles. It will cost about $200,000 to build the line.

WAUKESHA, WIS.—A company has been formed under the title of the Waukesha Beach Railway Company, composed of A. M. Jones, W. P. Sawyer, T. E. Ryan P. J. Buckley and George B. Harris. The object is the construction of a line of railway between this point and the lakes to the north. The capital stock is $75,000. Surveyors were put to work on the line between here and Pewaukee lake, where a tract of land has been purchased, and which is to be used for resort purposes in connection with the railway project.

MISCELLANEOUS NOTES.

THE UNIVERSITY OF ILLINOIS, Champaign, Ill., announces that the engineering department will occupy the new Engineering Hall this fall, which is one of the largest and finest buildings entirely devoted to engineering education in this country. The electrical engineering laboratory is supplied with various types of direct and alternating current dynamos, storage batteries, measuring apparatus, arc and incandescent lamps, photometers and numerous other appliances. The department of electrical engineering, which is in charge of Professor D. W. Shea, will be pleased to receive trade catalogues or printed matter. There is abundant space for framed photographs, and for filing blue prints and drawings; also cases for specimens, models and samples of manufactured specialties. Articles of historical engineering will also be welcomed.

RIVALS OF PENNOCK.—The New Haven, Conn., "Leader" states that arrangements have been completed by Dr. W. B. Beebe, of Bridgeport, Conn., to organize a company with a capital of $300,000 to exploit an invention of George T. Drabble, of Northampton, Mass., which is described as "a great improvement on the Pennock system, which is now being introduced with so much satisfaction." The apparatus, we are told, consists of a motor by means of which the regular current furnished by electric lighting companies can be so multiplied so that "many times the number of lamps now used can be lighted without losing a single iota of candle power." It is stated that while the Pennock system is now used to light four lamps with the same amount of energy required for one lamp by usual means, by the Drabble improved system in an actual contest 144 lights were obtained from a 32 light dynamo. The following additional information is given by the newspaper: "The apparatus is about to undergo a severe test at the psychological laboratory of Yale University. The test will be made by J. J. Hogan, who is in charge of the mechanical department of that institution. The laboratory is undoubtedly the best equipped of the kind in the country, the apparatus being gotten up chiefly under the direction of Dr. Scripture, one of the foremost psychologists in America. The test is being made for the purpose of establishing the efficiency of the apparatus beyond any sort of doubt." We learn that a son of an ex-Governor of New Hampshire, living in Keene, N. H., is also interested in a similar device, and that a third rival of Pennock has recently cropped up in New York City.

Trade and Industrial Notes.

THE FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has been informed that the Antwerp Exposition has awarded a medal of honor to the Green Patent Fuel Economizer.

C. S. VAN NUIS, 136 Liberty street, New York, has issued a handsome 20-page catalogue of the Ajax Lightning Arrester, in which this ingenious appliance is very thoroughly described and illustrated.

THE HEINE SAFETY BOILER COMPANY has secured the contract for new boilers for the Chicago city lighting plant, their bid of $19,310 being accepted, though $4,500 higher than the lowest bid.

MR. E. G. BRUCKMAN, Equitable building, St. Louis, has been highly complimented by the local newspapers upon the manner in which he executed the electrical construction work in the new Union railway station.

THE HELIOS ELECTRIC COMPANY, of Philadelphia, reports vast improvement in business, having recently sold 250 lamps to the Missouri Electric Light Company, of St. Louis, Mo. The Helios Company is now running full time.

THE BULLARD MACHINE TOOL COMPANY, Bridgeport, Conn., succeeds to the business of the Bridgeport Machine Tool Works. The change is merely in name, Mr. E. P. Bullard, promoter, becoming president of the newly incorporated company.

MR. C. O. BILLOW, fuel oil expert, of Chicago, who had charge of the designing, construction and maintenance of the entire World's Fair fuel oil equipment, is now in Philadelphia on his way east on a trip combining business with pleasure.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the shipment last week of two of its 1,000-light, ring type dynamos, with complete switchboard, for the new Davidson Theatre at Milwaukee, Wis. This order was seccured through Mr. J. Holt Gates, of Chicago, the well-known Western contractor of the Mather company.

CHAS. A. SCHIEREN & CO., Nos. 45, 47, 49, 51 Ferry, cor. Cliff streets, have just received a testimonial letter from the J. I. Case Threshing Machine Company, Racine, Wis., reading as follows: "We have had your perforted belt in use ever since you sent it, and it stands the work in good shape. We use it on a place where it tries the belt thoroughly, and it is perfectly satisfactory."

THE DETROIT ELECTRICAL WORKS has sold its entire stock of electrical house goods to the Central Electric Company, of Chicago. Mr. McKinlock says that it is the cleanest and best stock of electrical house goods that it has ever been his fortune to buy. The bells, batteries, annunciators and pushes are all standard goods of the latest and best designs. The house goods department of the Central Electric Company has issued a complete list of this stock, quoting prices.

THE JOHNSON ELECTRIC SERVICE COMPANY, 39 Clifford street, Park Place, Detroit, Mich., has issued a 40-page catalogue illustrating and describing its various devices for heat regulation in buildings. The engravings are well executed, and the descriptions enable all of the various details to be clearly understood, while a list of many hundred buildings in which this service is installed and numerous commendatory letters, show the estimation in which it is held.

THE NEW TARIFF BILL is issued in pamphlet form, fully digested, by F. B. Vandegrift & Co., Custom House brokers and United States tariff expertsf 27 William street, New York, Over 12,000 articles are indexed, while the rate o duty, paragraph of the law and decisions of the courts, of the General Appraisers, and Treasury Department are given; also a complete list of articles on which drawback has been allowed, with the amount of wastage, now published for the first time, and a table of foreign coins with values as fixed by the Director of the Mint; in addition there is a foreign express tariff and the administration law and other law on the administration of the customs service. This book should be very useful for those engaged in importations.

VOLUNTARY RECEIVERSHIP FOR H. WARD LEONARD & CO.—H. Ward Leonard & Co. have voluntarily gone into the hands of a temporary receiver. Mr. H. Ward Leonard has been appointed temporary receiver for New York State, where the most important assets of the company are located The receivership was the result of a friendly suit brought by the Interior Conduit & Insulation Company at the request of H. Ward Leonard & Co., and the bill shows assets amounting to about $177,000, and liabilities amounting to about $62,000. $109,000 of these assets have been locked up in a suit against the Cayadutta Electric Railway Company for over a year past, and are likely to continue so for several months to come. H. Ward Leonard & Co., being a foreign corporation and subject to attachment, the directors deemed it best for the interests of the creditors and stockholders to place the affairs of the company in the hands of a receiver until the settlement of this suit, when, it is claimed, there will be not only ample assets to settle all claims in full, but abundant means for the stockholders to resume business with.

Business Notices.

WHAT WILL THE NEW YORK CENTRAL DO NEXT?—After having his thirst netted, like a tiger by the taste of blood, by the wonderful performances of Engine No. 999, the genie who presides over the transportation department of the New York Central Railroad is rampant again, and laboring persistently to find means of attaining the speed of lightning. He is at work in his cell, by stealth and at midnight, and before many moons have passed we expect to see a terrible apparition coming up the Hudson River like the war chariot of Jove. We may expect a monster engine, with double boilers of enormous power and wheels as tall as a shot tower, which will trot up to Albany in an hour, skip over to Utica or Syracuse at half an hour schedules and cover the distance from New York to Buffalo in three hours. Then we shall need some means of artificial respiration.—Medford (Mass.) "Mercury."

Illustrated Record of Electrical Patents.

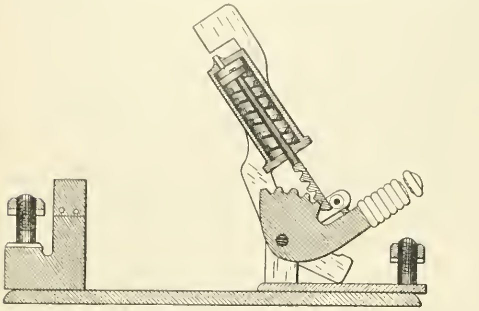
UNITED STATES PATENTS ISSUED SEPTEMBER 4, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building New York.)

525,390. STEAM TURBINE DYNAMO; J. F. McElroy, Albany, N. Y. Application filed December 19, 1893. The combination with a frame of a shaft composed of a flexible portion carrying the armature, and a rigid portion carrying the steam wheel and bearings supporting said flexible and rigid portions in fixed relation with each other.

525,332. ELECTRIC SWITCH; G. F. Card, Covington, Ky. Application filed April 14, 1894. This comprises a plate carrying the contacts, a plate insulated therefrom, a lever, a swinging frame having contacts adapted to engage with the stationary contacts, an air cylinder, a piston therein, and a connection between the piston rod and the lever whereby the piston rod may be actuated.

525,336. CONTROLLING DEVICE FOR ELECTRIC RAILWAY CARS; W. H. Conrad, Lebanon, Pa. Application filed January 8, 1894. This comprises a



No. 525,332. ELECTRIC SWITCH.

switch, a controlling shaft, a revoluble sleeve secured thereto, a ratchet wheel secured to the sleeve, a pawl, an arm on the shaft to release the pawl and a brake chain attached to the sleeve.

525,353. DYNAMO ELECTRIC MACHINE; J. F. McElroy, Albany, N. Y. Application filed January 10, 1891. This comprises a circular range of fixed electro-magnets divided into two groups, one having its coils connected to the magnetizing circuit and the other into the induced circuit.

525,354 ELECTRICAL CURRENT DIRECTOR; J. F. McElroy, Albany, N. Y. Application filed July 1, 1891. This consists in directing the alternating current through oppositely extending branches of the alternating current circuit, creating an opposing resistance alternately at opposite points of the branches and finally directing the current from one branch through a main line circuit and back through the other branch.

525,369. ELECTRIC LIGHTING SYSTEM AND APPARATUS; E. Thomson, Lynn, Mass. Application filed February 21, 1887. This comprises primary or secondary helices, either or both of which are suitably mounted so as to be separated from one another and from the iron mass of the apparatus by a free air space.

525,394. CONTROLLER FOR ELECTRIC OR OTHER MOTORS; E. A. Sperry, Cleveland, O. Application filed July 21, 1894. A brake handle having a certain critical position, a separate motor controller handle, and means for locking the latter when the brake handle is in other than its said critical position.

525,395. SYSTEM AND APPARATUS FOR CONTROL OF ELECTRIC MACHINES; E. A. Sperry, Cleveland, O. Application filed July 24, 1894. In a controller, a moving part of the controller, and a pendulum actuated stop for the moving part.

525,400. ELECTRIC LOCK; F. Apitz, Lockport, Ill. Application filed May 31, 1894. This comprises a circuit breaker and a battery, whereby the lock bolt is prevented from being moved backward by the key until released by the electric current.

525,437. ELECTRIC CIGAR LIGHTER; A. C. Albertson, Chicago, Ill. Application filed November 29, 1893. This comprises an automatic switch, a circuit wire, and a casing to enclose said switch.

525,445. SYSTEM OF ELECTRICAL DISTRIBUTION; T. C. Coykendall, Rondout, N. Y. Application filed January 4, 1894. This comprises a dynamo, mains leading therefrom, an electro-magnetic break switch in series with one of the mains, a relatively high resistance shunt around the break switch, and an ammeter in circuit with the shunt.

525,446. SYSTEM OF ELECTRICAL DISTRIBUTION; T. C. Coykendall, Rondout, N. Y. Application filed January 18, 1894. The combination of a source of electric energy, mains leading therefrom, a break switch, a shunt around the break switch, and means for restoring the break switch controlled by the flow of current in the shunt.

525,447. ALTERNATING CURRENT MOTOR; O. Dahl, Paterson, N. J. Application filed December 3, 1892. This comprises an armature having two sets of windings, one being a distributive winding for purposes of starting and the other a concentrated winding for purposes of synchronism.

525,480. ELECTRIC RAILWAY SYSTEM; F. B. Badt, Chicago, Ill., application filed October 22, 1893. This comprises a movable vehicle, a motor transformer, conductors, one or more direct current motors on the vehicle, and connections from the transformer to the direct current motor.

525,490. HEAT REGULATORS FOR INCUBATORS. H. R. Davis, Cardington, O. Application filed August 31, 1893. This comprises a normally open circuit, a thermostat for closing the same, electro-magnets in said current, a lamp, a pointed lever, a damper, an armature controlled by the magnets, and a pivoted hook adapted to engage the burner of the lamp.

525,491. ELECTRIC BATTERY; L. Drescher, New York. Application filed March 23, 1894. A galvanic cell having a chamber formed in its end, the end walls of the vestibule being perforated.

525,505. ELECTRO-MAGNETIC CAR BRAKE; R. T. Murray and C. M. Allen, San Francisco, Cal. Application filed October 24, 1892. This consists of vertically moving brake shoes adapted to form contact with the rails, an electro-magnet carrying the same, coils surrounding the core thereof, switch plates and a switch lever, and a returning spring whereby the switch lever is actuated.

525,523. ELECTRO-MAGNETIC TRACTILE DEVICE; C. M. Allen, San Francisco, Cal. Application filed August 22, 1893. This consists of an electro-magnet movable toward and away from the rails, and movable inclined planes engaging the magnets for raising them, the latter being depressed by gravitation.

525,539. CONDUIT ELECTRIC RAILWAY; O. A. Enholm, New York, N. Y. Application filed April 17, 1894. A switch mechanism comprising a movable contact a contact in normal engagement therewith, and contacts, normally out of engagement therewith, the movable contact having portions adapted to engage the contacts, a crank connected with the movable contact, a separate crank and devices for causing joint operation of the cranks toward them and from each other.

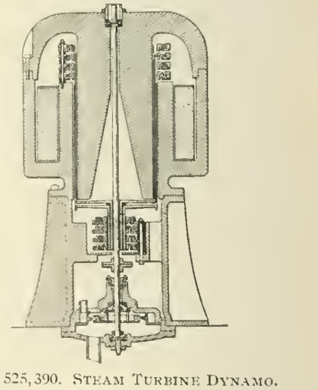
525,548. FROZEN WATER ALARM; W. Humberstone, London, England. Application filed May 14, 1894. This comprises a cylinder containing a flexible diaphragm, a lever pivoted above the same and connected thereto, a pivoted plate, a catch to hold the plate in position to conceal a warning notice, and a catch whereby when the lever is released the plate will also be released and the notice disclosed.

525,563. ELECTRICAL CUT-OUT; A. Rockoff, New York, N. Y. Application filed May 10, 1894. A cut-out having a socket comprising two compartments, spring contact pieces in the lower compartment, plates in its upper compartment, and a fusible wire conductor between the plates.

525,584. RAILWAY SIGNALING BY MEANS OF DETONATING OR EXPLOSIVE MATERIAL; H. Brocklehurst, London, England. Application filed November 3, 1893. The combination with a lever moved in accordance with the movements of a lever which is worked in connection with an ordinary visual railroad signal, of a link, arm, shaft, ratchet wheel, arm, pawl, link, stop catch, wheel, recesses in the wheel, and a reservoir.

525,598. OVERHEAD SWITCH FOR TROLLEY WIRES; H. M. Greenwood, Brooklyn, N. Y. Application filed December 1, 1893. This comprises a body and wire arms, one of the arms being adjustably connected to the body whereby its position can be shifted to adapt it to the wires of the trolley line.

525,649. DISTRICT TELEGRAPH CALL; W. H. Garven, Portland, Ore. Application filed February 19, 1894. This comprises a telegraph call, a cam arranged on its winding shaft, a slide bar adjusted by the cam, and a plate bearing pictorial illustrations of the different calls arranged to be progressively brought in view according to the throw of the winding shaft and cam.



No. 525,390. STEAM TURBINE DYNAMO.

525,653. ROSETTE FOR ELECTRIC LIGHT WIRES; C. N. Hammond, Boston, Mass. Application filed January 15, 1894. A rosette having side holes through which the ends of the lamp cord may extend, strips loosely fitting the side holes, and binders applied to the outer ends of the strips and entering cavities in the body of the rosette to check endwise movement of the strips in the holes.

525,670. UNDERGROUND CONDUIT; A. Segdae and D. J. O. Reagan, Detroit, Mich. Application filed March 6, 1894. The combination of a casing, an outer sleeve projecting beyond the casing at each end, blocks adapted to fit against the end of the sections and within the sleeves, ducts in the casing and complementary ducts in the blocks.

The Electrical World.

VOL. XXIV. NEW YORK, SEPTEMBER 22, 1894. No. 12.

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VOL. XXIV. NEW YORK, SEPTEMBER 22, 1894. No. 12.

CONTENTS.

A PROMISING SUGGESTION.

Elsewhere in this issue, Mr. S. D. Mott describes a principle for the construction of a new and very neat substitute for the electric bell or buzzer, whose practical realization offers an opportunity for an interesting experiment. Such a device would be sightly in appearance and its sound would be a great improvement over that of the present forms of bells and buzzers. In some forms of chronographs a definite rate of vibration is obtained through the making and breaking of a current by a tuning fork, one arm of which is attracted by a magnet at the make and released at the break, the fork being thus set in vibration. A steel spring may be used instead of a tuning fork, and would seem to be preferable, as by moving an adjustable weight along its length its period of vibration may be adjusted within wide limits and thus be made to correspond to the period of the receiving device instead of making the latter accord with a tuning fork. For experimental purposes two tuning forks of the same rate of vibration, one acting as receiver and the other as interrupter, could be used. For practical use two weighted springs might be substituted, as these could both easily be tuned in acccord with each other and to the pitch of musical note. The experiment would be an interesting and inexpensive one and is well worth making.

THE FEEDER AND MAIN DECISION.

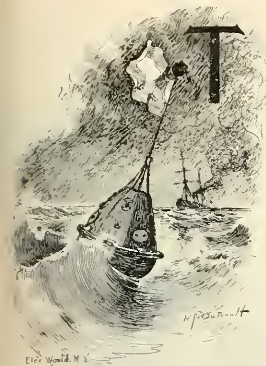
In another column we give an abstract of the opinion of Judge Acheson on this important suit, which reverses the previous decision rendered by Judge Green and nullifies the Edison-feeder and main patent. The result was not unexpected, or, at least, little weight was given in electrical circles to the opinion of Judge Green, which was remarkable in several respects aside from its legal one. The learned judge in his attempt to be scientific was little less than ludicrous, and it may be that an appreciation of this fact by the higher court accounts for its somewhat contemptuous treatment of Judge Green's opinion. As will be seen, the decision adverse to the patent is based upon two grounds; first, that the principles involved had long previously been employed in electroplating and was also ante-dated in Khotinsky's patent of 1875, and second, that the plan of distribution covered by the claims in question is not "the creative work of that faculty which it was the purpose of the Constitution and the patent laws to encourage and reward." It is denied that the patent in suit solved the problem, as claimed, of economically supplying lighting currents to circuits covering large areas, portions of which are at a great distance from the source of electrical energy. On the contrary it is asserted that the problem only involved the exercise of common skill and knowledge on the part of the electrician, and it is implied that the principle would have been as a matter of course taken advantage of, when, shortly after, the commencement of the growth of electric lighting brought forth the occasion of its use. As the feeder and main principal had been for years treated almost as public property, the effect of the decision on General Electric profits will be negligible, and had the patent been annulled a year earlier considerable feeling due to recent suits against minor firms on an alleged forced construction of the patent would have been avoided

SINE FORM OF CURVES OF ALTERNATING E. M. F.

We reprint elsewhere in this issue the reply of the London Electrician to the numerous criticisms which have appeared in our columns directed at our esteemed contemporary's dicta in regard to the uselessness of the sine form of alternating E. M. F. The two statements in particular to which our correspondents have taken exceptions are as follows: "The elaborate attempts which are being "made by some of the American alternator builders to give this

"property (of generating sine E. M. F.'s) to their machines are "utterly useless and a complete waste of time and energy," and "we "would not be surprised to find that the sine curve should be "carefully avoided, and that the best curve is of a very different "shape." Before commenting upon the reply of the *Electrician* we will recapitulate briefly the evidence thus far presented in favor of and against the sine curve. Professor Rowland in an article in The Electrical World of December 10, 1892, for the first time, as far as we know, referred to the injurious effects of the harmonics always present in non-sinusoidal E. M. F's. He pointed out that they were the cause of losses, though small, in transformers, but of serious deleterious effect in power transmission, and it was pronounced "of the first importance in the transmission of power that the "curves shall be pure sine curves, and dynamos, transformers and "motors must be designed in the future with reference to this point." We shall refer later on to the conclusion of Professor Rowland in the same article on the effect of harmonics in hysteresis. As bearing on the same point, Mr. John F. Kelly in the discussion which has recently appeared in our columns, gives an instance of a 40-h. p. motor that was practically inoperative when driven from an alternator with very irregular waves. Dr. Duncan quotes Mr. C. F. Scott as authority for a somewhat similar case, and Messrs. Houston and Kennelly refer in general terms to the deleterious motor reactions produced by harmonics. Mr. Steinmetz and Dr. Bell ascribe the deleterious reaction as a property of the two-phased motor, and the former states that the third harmonic does useful work in three-phased motors; Professor Blondel, however, says that the effect of that component is nul in synchronous motors. In view of these opinions a general denial of this reactive torque, such as is implied in the comment of the *Electrician*, or the assertion that the examples adduced in its favor prove nothing, merely evade the question. As to the loss from the C^2R effect of reactance currents incident to non-sinusoidal E. M. F.'s, Messrs. Rowland, Kennelly and Houston, Fessenden, Ryan and Blondel all lay stress upon the importance which it may assume. We may add that in a case which came under our observation, the volt ampere current to run an induction motor was 7 amperes when the equivalent current in phase with the E. M. F. was only 1.8 amperes. Prof. Ryan in this connection makes the interesting statement that there will be no reactance current if both the generator and motor have an E. M. F. of exactly the same form, to which Prof. Blondel assents. Since this identity should exist, at least approximately, the query of Professor Ryan is much to the point—"Is there any form for a standard which presents more "advantage and introduces fewer constructional difficulties or ex-"penses than the sine form?" In regard to the greater loss from eddy currents with non-sinusoidal E. M. F.'s, all are agreed and no denial is entered by the *Electrician.* Nor does our contemporary specifically deny that the inductive drop of lines is thereby increased, though statements of Messrs. Houston, Kennelly and Dunbar involving this point are somewhat captiously criticised. This effect to our mind, is one of the most important, from its practical bearing on electric lighting, for inductive drop with sine currents on lines with small capacity is itself a sufficient evil without being further augmented by the use of non-sinusoidal E. M. F.'s, which besides will be still less affected by capacity. Thus far the evidence has all strongly inclined to one side of the question, but when we come to hysteresis it is different. Prof. Rowland, in the article above referred to, states that the effect of harmonics on hysteresis is complicated, but after discussing the question from two different hypotheses he concludes that "It would seem, then, that the "losses due to hysteresis and current heating may be much increased "by the harmonics." Messrs. Houston and Kennelly, Dunbar and, Fessenden positivelj state that the hysteresis loss is increased with non-sinusoidal currents. Messrs. Bell, Ryan and Kelly refer to the increase of iron losses, which may either imply that there is a loss from hysteresis, or that the increase of the eddy loss is greater than the reduction, if any, in the iron loss from hysteresis. Steinmetz, on the other hand, asserts that a peaked E. M. F. curve reduces the hysteresis and gives strong reasons in support, and owing to the weight of his authority, this branch of the subject may be considered an open one, as it is apparently assumed to be by Professor Blondel. It may be pointed out, however, that this advantage, if it exists, does not apply to flat-topped curves of E. M. F., in which the hysteresis would be greater than in the sine form, and that with the peaked curve the advantage would not necessarily apply in all cases, owing to the increase of eddy loss in some instances probably overbalancing the hysteretic gain. This latter consideration may be the explanation of the resultant loss found by Prof. Ryan and Dr. Bell, assuming the correctness of the principle laid down by Mr. Steinmetz. On the same assumption, the experiments quoted by Mr. Steinmetz seem merely to point out the resultant gain by hysteresis and therefore do not imply the absence of losses from reactance and foucault currents, and do not touch upon line losses or drop at all. Prof. Blondel points out the danger from resonance with non-sinusoidal currents, which Mr. Steinmetz admits with the statement that a line which is liable to give rise to such a danger from resonance is not fit for use with the fundamental wave either. In reply to the various views and statements we have thus briefly outlined, our contemporary exposes the weakness of its position by the manner in which it treats the evidence presented. In regard to the case quoted by Dr. Duncan, it states that "it only shows that "one particular non-sine curve was worse than the sine curve with "one particular motor," thus entirely evading the general principle of harmonic motor-reaction which is really the issue. The statement "Finally, we would remark that since the flat-topped "curve is best for general distribution purposes, best for transformer "and generator efficiency, and as good, at least, for lighting purposes "by glow lamps, and, if we understand Herrn Rossler and Wedding "aright, better than a sine curve or a peaked curve for arc lamps "it is therefore to the interests of makers to cultivate this type "of curve," is, to put it mildly, a surprising one. In the first place the arguments which our contemporary uses refer to the peaked and not to the flat-topped curve of E. M. F., as it itself acknowledges in the succeeding issue. No argument whatever is adduced or even referred to that supports the claim of the superiority of any non-sinusoidal curve for general distribution purposes or for generator efficiency. It only grants the sine curve to be "as good, at least, "for lighting purposes by glow lamps," thus giving least weight to the strongest argument against it, and the only one for which it brings forth any support. Finally, in direct contradiction, Herrn Rossler and Wedding state, "The sine current gives the best results; "the development of light is fair, and the arc is silent." At the present stage of this interesting controversy it may be fairly said, we believe, that, even assuming a reduction of hysteresis with a peaked curve, the sine curve is in general best for the reasons that with it line drop, reactance currents, resonance, and eddy losses have minimum values; reactive torque in motors is absent or reduced and the disagreeable humming of arcs is avoided, which latter is an advantage of a most important practical character. It offers itself as being the simplest form for the standard which is desirable, not only on account of the identity which should exist in the characteristics of generators and motors working together, but also from allowing results to be predicted with more precision than is otherwise possible. Its general adoption would obviate the necessity of adjusting alternating arcs to each machine with which they are used, and thus placing them at a disadvantage with direct current arcs. To quote Professor Blondel, "The employment of a sine E. M. F. can never "be injurious; it is always to be recommended with a view to "precision, and is often indispensable; in certain cases it assures an "important superiority of efficiency; in others this superiority is "practically negligible. Under very frequent circumstances, "in particular where transformers are employed, the realization of "a sine E. M. F. is absolutely visionary, ulterior causes deforming "the secondary in such a manner as to render entirely useless most "often the efforts made to obtain the sine form in the generat-"ing machine." The latter cases, however, unless questions of cost or expedience intervene, would seem to give no reason for discriminating against the sine form.

The First Direct New York Cable.

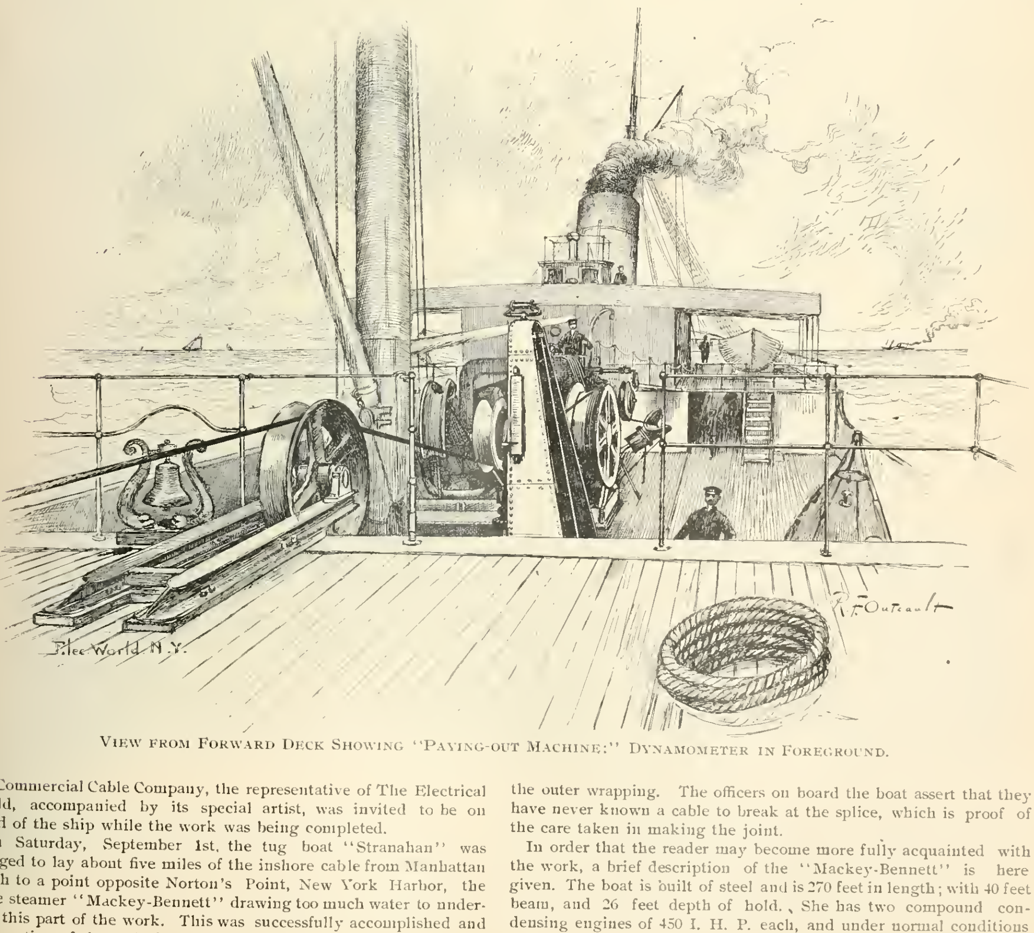


TO have an Atlantic cable landed 2,000 miles away from New York was thought a great thing in 1866, and in 1856, when Mr. Cyrus W. Field organized the first Atlantic cable company, it is quite presumable that he never even thought that a cable connecting the Old World and the New would be brought directly into our great metropolis. But the time has come when such is actually the case. With the laying of the Commercial Cable from its former terminus at Manhattan Beach, Coney Island, to Pier A at the Battery, on September 1st and 2d, New York was placed in direct communication with the heart of Europe. There is probably no similar city in the world that enjoys such great advantages as New York now has with the completion of this work. The Commercial Cable Company's system is so perfect that it is said that a question could be asked of London and an answer received inside of three minutes.

It will probably be interesting to many of our readers to describe the process by which this great work of cable laying is done. Through the courtesy of Mr. George G. Ward, vice-president of the Commercial Cable Company, the representative of The Electrical World, accompanied by its special artist, was invited to be on board of the ship while the work was being completed.

On Saturday, September 1st, the tug boat "Stranahan" was engaged to lay about five miles of the inshore cable from Manhattan Beach to a point opposite Norton's Point, New York Harbor, the cable steamer "Mackey-Bennett" drawing too much water to undertake this part of the work. This was successfully accomplished and the location of the end of the cable was marked by making a buoy fast to it before lowering it into the water. At 7.30 the next morning, Sunday, September 2d (Sunday having been selected because the harbor is free from the usually heavy traffic), the tug "William J. McCaldin" called at the Marine Club wharf and took on board the favored few, from whence they were transported to the "Mackey-Bennett" lying off Norton's Point. Among the visitors aboard the vessel were John W. Mackey, Jr., director of the Commercial Cable Company; E. Lambert Lynch; G. H. Usher, assistant superintendent of the Postal Telegraph-Cable Company; T. L. Cuyler, Jr., assistant treasurer of the Postal Telegraph-Cable Company; J. H. Smart, assistant superintendent of the Commercial Cable Company; J. H. Emmerich, superintendent of the Postal Telegraph-Cable Company and Charles Cuttriss, chief electrician of the Commercial Cable Company.

The end of the cable had been brought aboard the ship and the operation of splicing the cable laid on Saturday to the remainder in the tanks of the vessel was going on. The armor and insulation was first removed from the core of the cable, which, in this instance, was composed of four conductors, each being made of seven small copper wires. These cores are thoroughly cleaned and the ends nicely scarfed and soldered together. The joint is then wound with fine copper wire which is also firmly soldered to the core wire. The acid used in soldering is then thoroughly washed off and the gutta percha insulation replaced. The inner armor wire is then put in position and served with fine twine. This completed, the protecting armor is replaced and served with "marline," or "spun yarn" as the sailors choose to call it, soaked in tallow, completing the splice. It is practically the same size as the rest of the cable, and the joint can only be distinguished from the original cable by the outer wrapping. The officers on board the boat assert that they have never known a cable to break at the splice, which is proof of the care taken in making the joint.

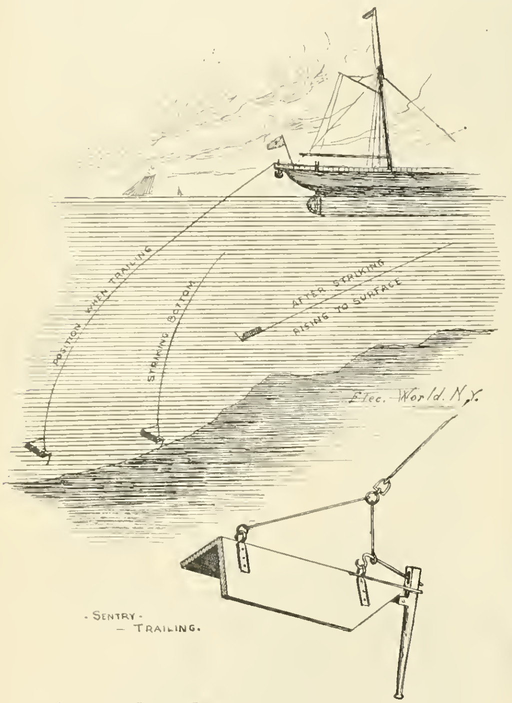


View from Forward Deck Showing "Paying-out Machine;" Dynamometer in Foreground.

In order that the reader may become more fully acquainted with the work, a brief description of the "Mackey-Bennett" is here given. The boat is built of steel and is 270 feet in length; with 40 feet beam, and 26 feet depth of hold. She has two compound condensing engines of 450 I. H. P. each, and under normal conditions can make about 12 knots per hour. Her coaling and fresh water

capacity is sufficient for a six weeks' cruise. She is lighted through out by electricity. Search lights are provided so that cable operations can be carried on at night. Twin screws and steam steering apparatus render her manœuvering qualities excellent and make it possible to turn in her own length. A bow rudder is provided for efficient steering when going astern. Refrigerating apparatus has been installed, carbon dioxide being the cooling medium instead of the usual ammonia process.

In the hold there are three immense iron tanks, 34 feet in diameter, for the storage of cable, each having a conical core for guiding the cable when it is being paid out. The space within these cores is utilized to hold fresh water. The capacity of the tanks is about 1,400 tons of cable, this being the equivalent of about 100 miles of inshore cable weighing 14 tons to the mile. The weight, however, varies according to the location. Cables in shallow water are made with heavy armor and insulation, while the deep sea cable is quite light. Special cable has to be used in the region about Halifax, owing to

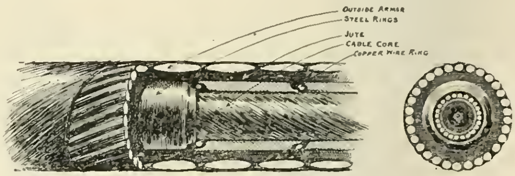


"Kite," of the James Sentry and Sounding Machine, Showing Method of Operation.

the grounding of icebergs. This is shown in one of the illustrations and is composed of the usual core with an armature of steel rings which are in turn covered with the outside armor. The diameter of this cable is about two and three-quarters inches and it is so strong that when an iceberg bears upon it the ice is crushed before any injury is done to the conductors. The cable tanks are all connected by "ways" or troughs so that a transfer may be made from one tank to another or from any tank to either one of the paying-out machines. Any handling of the cable made necessary by such transfers is usually done by means of a small Brotherhood engine connected to a drum and all mounted on a truck by which it may be moved about the deck.

Returning to the description of the ship, there are two paying-out machines, one of which is partially shown in the illustration. They are made up of massive gears operated by double cylinder engines set at an angle of 90 degrees to each other, making it out of the question to have both engines get on dead centre at the same time. The gears operate a large drum which controls the speed of the cable in the operation of laying or hauling in when making repairs. The operation of the machine is controlled from a platform conveniently located above the gears and from which the scale of the dynamometer is in plain view. The latter is shown in the cut, and consists of a massive iron upright, the upper portion of which forms a guide for the cable sheave. The strain is measured by a heavy coil spring in tension, and the movement of the sheave is made steady by the action of a piston working in a cylinder containing glycerine, the piston being connected to the sheave by the usual piston rod and yoke.

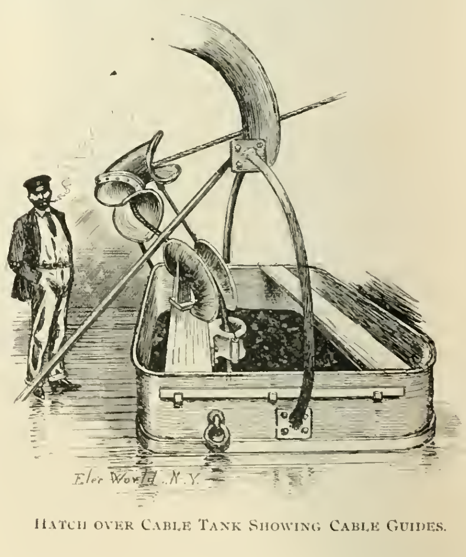
At either end of the boat and projecting out several feet, are self-adjustable sheaves about five feet in diameter, over which the cable passes when being lowered into the water. Surrounding these sheaves are iron platforms upon which the commanding officer stands while the cable is being laid. At the stern of the boat is a "James submarine sentry and sounding machine." It consists of a device, shown in one of the illustrations, known as the "kite" which is attached to a piano wire wound upon the drum of the sounding machine. It is used as a sentry when working in uncertain water or



Protected Cable for Use in Region of Icebergs.

when it is desired to have the cable laid in water not shallower than a depth decided upon beforehand. The manner of operation is quite clearly shown in the cut. The "kite" when set, dives immediately under the stern of the boat to the minimum depth desired. Should the boat sail into shallower water than desired, the lever at the lower end of the "kite" strikes the bottom, releasing the tow line at one end, thereby changing the position of the "kite" which immediately rises to the surface. At the moment of release the tension upon the tow line is suddenly decreased and causes a bell on the machine to ring and also one on the navigating bridge.

Located in convenient places about the ship are several electric telegraph signaling machines made by Elliott Brothers, of London.



Hatch over Cable Tank Showing Cable Guides.

Some are for communicating with the engineer of the paying-out machines, while others are for signaling the engineer of the ship.

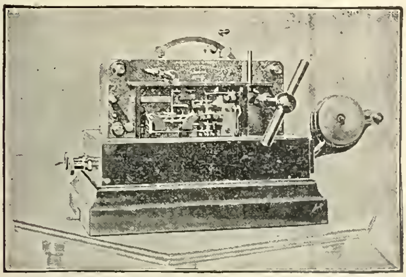
The testing room, located on the forward deck, has been thoroughly equipped with the finest of electrical measuring instruments. There is a complete set of instruments for each of the several tests required in locating faulty insulation, doing away with the necessity of changing connections. This department is in charge of Mr. C. Priest, electrician of the ship.

As the cable is brought from the tank it passes through an iron ring immediately over the centre of the hatch, thence around a

deeply grooved iron guide, and the friction of the cable at this point acts as a tension; it then passes several times around the drum to the paying-out machine and underneath the pulley of the dynamometer, over several pulleys on the deck and out over the sheave at the bow or stern to its final resting place at the bottom of the sea.

It is sometimes preferred to lay the cable from the bow of the boat, as it is a more advantageous point from which to direct the work.

The cable, in passing under the dynamometer pulley, is considerably depressed, and as the strain increases or decreases, a pointer at each side passing over graduated scales fastened to the uprights indicates the strain in tons. The strain upon the cable ranged from 2 to 3 tons and in no instance was it allowed to reach more than 10 tons for the type of cable which was used.

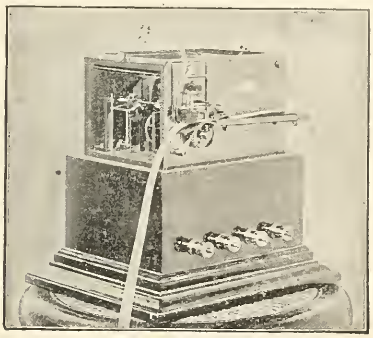


Wilmot Automatic Transmitter.

The cable can be laid at the rate of 6 to 8 miles per hour, but the speed with this cable was but about 3½ miles, pier "A" being reached shortly after one o'clock Sunday afternoon. Upon reaching its destination the cable was cut and the end securely fastened to the dock. The following morning the splice was made to the underground cable recently laid from the pier to the office of the company, corner of Broad and Wall streets, completing a work that will be invaluable to the business interests of New York.

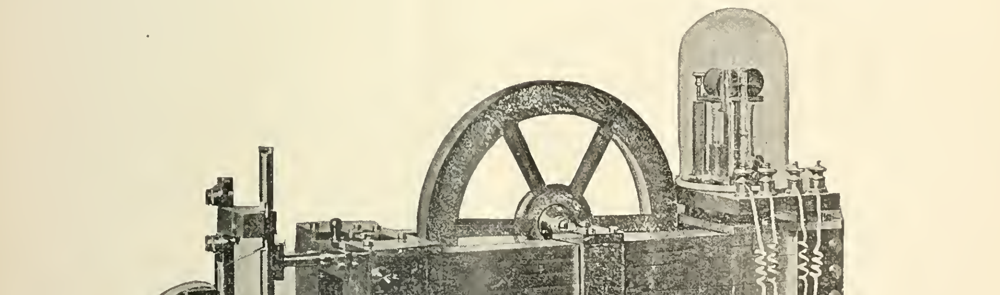
A brief description of the various apparatus employed in sending and receiving cablegrams may prove of interest at this time.

It is popularly supposed that cablegrams are received by means of flashes of light; but that system is all but abandoned; in fact, the Commercial Cable Company never employed it, but adopted the recording system invented by Sir William Thomson (now Lord Kelvin). The instrument was very complicated when the company received it, and much care and attention was necessary to keep it in good working condition. It was, to a great extent, dependent on the weather, being difficult to operate well on damp, muggy days.



Cuttriss Automatic Transmitter.

The improvements effected by the company's electricians have removed all its weak points, and it is now one of the most reliable of telegraph machines. Its principal parts are a light rectangular coil of silk-covered wire and a powerful magnet. The coil is suspended between the poles of the magnet, and when excited by the electric current from the cable it swings upon a vertical axis. Its movements are recorded on a paper ribbon drawn at a uniform speed before the point of a fine glass siphon no thicker than a human hair, which conducts a stream of ink from a reservoir to the paper ribbon. The marking end of the siphon responds to and multiplies every movement of the coil, and leaves on the ribbon an inky trail, which is an exact and permanent record of the movements of the coil under the influence of the currents from the cable.



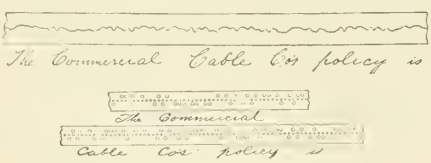
The Improved Siphon Recorder.

In the improved recorder, as devised by Mr. Charles Cuttriss, the Commercial Cable Company's electrician, and shown in one of the illustrations, the siphon is vibrated by magnetism. The coil is pivoted on jewels, and its motion controlled by magnetism so applied

as to take the weight of the coil off the pivot and hold the coil almost suspended in the air, thereby securing the maximum freedom of motion and of control. This method of controlling recorder coils renders them so extremely delicate that a speed of 250 to 300 letters per minute is constantly maintained. The Cuttriss vibrator, for vibrating the siphon of the siphon recorder, is shown at the upper right hand of the illustration just referred to. The siphon must be kept in constant vibration to do away with friction between its point and the paper ribbon, as otherwise no reliable record of the movements of the recorder coil can be obtained, the current from the cable being too feeble to overcome even a small amount of friction.

Two forms of automatic senders are in use and are shown herewith. Automatic transmission has been in successful operation on land lines for many years, but was not considered valuable, or even practicable, on long submarine cables until Mr. T. J. Wilmot, the Commercial Cable Company's superintendent at Waterville, Ireland, produced a modified form of Wheatstone automatic transmitter, and demonstrated conclusively that it was swifter and more accurate than keys manipulated by the hands. The signals received from an automatic sender are uniform in shape and size, whereas those from the hand vary with the operator. The automatic sender, therefore, not only does more work in a given time, but, what is much more important, the uniformity of its signals enables the receiving operator to translate them with greater certainty. The liability of error is consequently minimized.

Motion is imparted to the transmitter by means of a weight, and the electrical contacts are controlled by a paper ribbon perforated with three rows of holes as shown. The upper and lower rows



Message as Sent and Received.

determine the polarity of the current sent into the cable. The middle row engages a toothed wheel by which the ribbon is drawn along.

The second form of automatic transmitter also shown is novel in form and construction. It is the invention of Mr. Charles Cuttriss, and possesses important advantages. An important feature is the intermittent motion imparted to the ribbon, by which it is possible to vary the duration of current and earth contacts in any proportion of one to the other.

Sparking at the transmitting points is absolutely prevented by a cam device, which never opens the contacts while a current is passing through. In other words the cam makes and breaks contact when the circuit is free from current and consequently the points work bright and clean. The clock work and weight of the older forms are abolished and continuous motion is obtained from a self-governing electric motor, also the design of Mr. Charles Cuttriss, which will run efficiently with six cells of battery, and not vary its speed if placed in an electric light circuit.

One of the most important of the many uses of the standard condenser is to measure the inductive capacity of a submarine cable. When a cable is charged with the current from a battery, static induction is set up between the conductor and the water through the guttta-percha insulator. A part of the charge is retained and acts as a clog on the speed of the signaling currents. The less the inductive capacity the greater will be the signaling speed and consequently the greater the commercial value of the cable. The condenser is an apparatus which affords a means of determining by comparison the capacity of a cable. It is composed of a large number of alternate sheets of tinfoil and mica, the office of the mica being to separate the sheets.

An apparatus invented by Dr. Alex. Muirhead, of London, is used to accomplish on one wire the simultaneous transmission of messages in opposite directions and is known to electricians as "duplexing" the line. To do this efficiently, the electrical qualities of an ocean cable must be imitated is an artificial line. A continuous narrow strip of tinfoil represents the conductor in qualities of conductivity and resistance. Sheets of paper soaked in paraffine represent the gutta-percha insulation, and sheets of tinfoil represent the medium surrounding the cable. The artificial line is built up in the following order, repeated as often as necessary: Paraffined paper; tinfoil strips; paraffined paper; tinfoil strips. The strip of tinfoil is continued backwards and forwards upon the surface of the paper, the lines being separated by a space of ⅛ of an inch. The mass is then placed in containing boxes, two feet square by six inches deep. Metallic connection is made at frequent intervals with binding posts on the outside of the boxes.

This motor was designed specially for the purpose of drawing the paper ribbon under the point of the siphon. A sensitive governor regulates its speed, and, consequently, that of the ribbon. The speed of the ribbon must be regular to preserve uniformity in the record made by the siphon, otherwise the record could not be translated with any certainty. The ribbon moves under the siphon at the rate of 30 inches per minute. The governor, when once set, will maintain any given rate within the half of one per cent. The motors are so wound as to run equally well on an electric light circuit, or a battery circuit of six or more gravity cells.

The Feeder and Main Patent.

The United States Circuit Court of Appeals for the Third Circuit rendered an opinion on Tuesday of last week reversing the opinion of Judge Green, of the United States Circuit Court for the District of New Jersey, which had sustained the feeder and main patent. Judges Acheson, Dallas and Butler were on the bench and the opinion was written by Judge Acheson.

The court defines the patent as dealing with the one particular difficulty of drop, to remedy which the patentee provides special conductors extending from the generator to the main conductors with which the lamps are connected, and from which they are served, and is for a specific arrangement and proportioning of these two sets of conductors, which together constitute the complete circuit. The claims are stated to be perfectly clear and definite, and are for a single circuit composed of a pair of transmitting conductors and a pair of distributing conductors having the specified characteristics without regard to any other like circuit, and the gist of the alleged invention is stated to lie in the combination and proportioning of these two parts of the circuit and not in their use.

The court criticises the action of the court below in incorporating into each of the claims, which are stated to be pefectly clear and definite, limitations other than those expressed and which should have been excluded. The Supreme Court is quoted to the effect that it is unjust to the public as well as an evasion of the law to construe a claim in a manner different from the plain import of its terms.

The primary question for solution as laid down by the court, is whether any invention is involved in a patentable sense in combining a circuit for feeding only with a consumption circuit, the main conductors of which are so proportioned as to maintain such uniformity of pressure upon them that there is practically no variation in the candle power of the lamps connected therewith. In the present instance the patent in suit is declared to disclose no new means either for transmission of current or for equalizing pressure upon the consumption circuit.

It is pointed out that the patent leaves it altogether to the judgment of the electrical engineer or contractor to determine the relative length of the two parts of the combined circuit and the proper thickness of the conductors. Thus it is left where, the court states, it properly belongs—to the intelligence of the electrical engineer—to select feeding conductors of large or small diameter depending upon the apparatus or cost of copper or power, or upon some special circumstances. The feeding conductors of the patent are in truth nothing more than the ordinary supply wire running from the source of electrical energy and, as a matter of course, there are "no translating devices connected therewith." The statement in the specification that the drop upon the feeding conductors has no effect upon the relative candle power of the lamps, which is only affected by the drop in the main conductors, is declared to be a mention of an obvious fact. It is a quality inhering in the circuit by the very nature of things and is a necessary incident of any circuit, part of which supplies a current and part of which distributes it.

The knowledge how to secure uniformity of electrical pressure is assumed by the specification itself to be a matter of common knowledge, and, the court states it is, in fact, a matter of mere calculation, to aid which formulæ had been worked out prior to the date of the invention.

The court declares that in the art of electroplating as practiced long before 1880, an arrangement of circuits substantially the same as that of the patents in the suit was used, and that in Khotinsky's French patent of 1875 there was shown and described a circuit of

feeding and consumption parts identical in form with that of the patent in suit.

How can it be affirmed, it is asked, that it would require invention simply to proportion Khotinsky's circuit in the manner contemplated in the matter in suit—to make his trasmitting wires and transmitting conductors respectively of suitable size to perform their intended fuctions?

The court refuses assent to the suggestion that the alleged invention supplied a long felt want or met a difficultygenerally recognized in the art as a serious hindrance to the distribution of electric current. Prior to the application for this patent no incandescent light plant had been built, and there had been no occasion to erect such a plant, and electrical engineers had not been called upon to deal practically with the problem of drop in the construction of plants. In truth the feeder and main system of distribution came naturally in the progress of the art of incandescent electric lighting, as and when needed. A practical incandescent electric lamp had been invented and when the occasion for its use actually arose the feeder and main system were forthcoming. It is a great mistake to attribute to the patent in suit the merit of having solved the problem of economically supplying the electric current for extensive use to circuits covering large areas, portions of which are at great distances from the source of electrical energy. The economy of copper is confined altogether to the trasmitting conductors and the cost of copper restricts the use of this system to comparatively narrow limits. The extension of the incandescent electric light over large areas is really due to subsequent inventions, conspicuous among which is the alternating system.

The opinion sums up by stating that the multiple arc system of distribution being confessedly old, and the high resistance incandescent lamps being devised, to provide "feeding conductors to extend from the generator or generators, to the main conductors of the lamp of consumption current" was an obvious engineering expedient. Thereafter the proper proportioning of the two parts of the combined circuits involved only the exercise of the common knowledge and skill of the electrician. The plan of electrical distribution covered by the claims in question is not the creative work of that inventive faculty which it was the purpose of the Constitution and the patent laws to reward, and to sustain the patent would be to sanction a monopoly in that which belongs to the public.

Reference is made to the ruling of the Supreme Court in regard to the nullity of a patent for an invention that is described and claimed in a prior patent. The question raised in this case, which was in regard to an earlier patent of Mr. Edison's dated March 22, 1881, is declared to be a serious one, but the court considered it not necessary to take it up, as the views expressed upon the other branch of the case are decisive.

How to Make a Voltmeter and an Ammeter.—For Amateurs.

BY G. E. DUNTON.

These practical working instruments are so simple in construction that they come within range of any amateur's ability to make, and the writer of the following article will endeavor to make the description of the meters, as designed and constructed by him, so clear that any reader who may desire can construct instruments of his own that will do as good work. The construction of the two instruments, as far as the mechanical part goes, which will be taken up first, is identical, with the exception of one or two minor points which will be noted as we proceed; their real difference is in the respective windings and position in the circuit.

To commence with, purchase a piece of brass pipe 1½ inch internal diameter, and to give a finished length of 1 7-16 inch. Heat to a cherry red and plunge into water, to make sure that it is annealed properly. This must be flattened out carefully as shown in Fig. 1 section, the dotted circle denoting its original shape. Note carefully all measurements and dimensions given on the plans, as they will not be repeated in the descriptive text. On each end drill and tap six screw holes for 1-16 inch brass "Fillister head" machine screws, Fig. 1A section. Directly on the centre of side, drill a 5-16 inch hole completely through the brass, Fig. 1B, and ½ an inch each side of the centre of this hole drill through two smaller holes, tapping for 5-64 inch screws, Fig. 1C. The collars which go on the core, forming the wire spaces, are made from sheet brass, 1-16 inch thick. The two on the ends, shown in Fig. 1D section, and in Fig. 2, are drilled for the six screws with which they are fastened to the ends of the core. The two middle ones are made to slip on over the core, and are nicely soldered in place; Fig. 1E shows them in section, and the dotted lines in Fig. 2 show the size of the hole. There is a difference in these two washers on the ampere meter; instead of being plain, as in the voltmeter, there is a slight recess pressed into one side. This allows a space for the beginning end of the copper strips, used in winding, to be brought out from in under the coil. The dotted lines, Fig. 2B, show the shape and depth. This recess comes on the back side of the core, setting in toward the centre hole on the amperemeter only.

The hangers are made from 1-16 inch sheet brass, carefully annealed, cut out with a cold chisel and filed up to a nice finish. The front side hanger is longer, as shown in Fig. 3, than the rear side, as shown in Fig. 4, while the section is the same. The screw holes in the feet, A, are drilled to admit the screws with which they are fastened to the core. In the centre of each hanger, B, drill and tap holes for 3-32 inch screws, to be used for the adjustment of the movement of the instrument, and which should have a 1-32 inch hole drilled in to the centre of the threaded end to the depth of 1-16 of an inch, and also to be fitted with little check nuts, Fig. 5A and B.

The spindle on which the needles and pointer swing is made from the finest grade 3-32 inch steel wire, with both the ends sharpened down to a fine, smooth point, Fig. 6A. After cutting the wire off (a little longer than the finished length), square up with a file each end nicely to the exact length the finished spindle will be. The piece may be put in the lathe chuck, and at moderate speed pointed off nicely and smoothly with a fine file, finishing up with Scotch stone and water. The point should be ⅛ of an inch long. The little hubs or bosses for the needles and pointer are turned from round brass bar. The hub carrying the needles is drilled through its centre for the spindle, as shown in Fig. 7A. Fig. 6B shows it in place between the needles in section. The hub carrying the pointer is a little different, as shown in Fig. 7B and C, in plan and section. The hole for the spindle is drilled nearer to one side, and the shoulder on the back is turned on a radius with it. A hole drilled in this shoulder, as shown in Fig. 7D, is for a 1-16 inch set screw. The two needles shown in section Fig. 6C and Fig. 8 plan are made from the very best sheet spring steel, 1-32 inch thick, drilled through the centre, as shown in Fig. 8, and carefully swaged on to the brass hub, over the shoulders; or to be more correct, the brass bosses should be swaged out to hold the needles on, and the surplus brass filed off smooth. This, which is in reality the armature—in one sense mechanically, though not magnetically—should be put on the spindle temporarily, and accurately balanced so nicely that it will not come to rest twice in any one position. The balancing can *only be done* nicely on knife-edged ways. On the perfection of this part of the work depends the instrument's accuracy. Drill two holes through the hub into the spindle hole at right angles to each other (the armature of course being removed from the spindle), as shown in Fig. 7E and F, Fig. 1F and H; tap out for 1-16 inch screws. Carefully cut a thread on a piece of 1-16 inch brass rod a distance of ⅞ of an inch from the end; great care must be taken not to twist off the wire rod. Screw this into the hole on the under side of the hub and sweat it in with soft solder. Snip off the surplus wire remaining beyond the thread and smooth up the end, repairing the thread if jammed in cutting. This screw carries the thumb nut adjusting the balance weight, Fig. 1G. In making the accompanying drawings, the writer has tilted the needle shown in dotted outline, in Fig. 1, the wrong way. The middle of the end marked "N" should come just above the bottom of the upper coil-space, hanging nearly, though not quite, horizontal, and tilting just in the opposite direction from that shown in the plan, Fig. 1. This applies to both meters. The adjusting weight and thumb nut of brass are shown in Fig. 9.

The pointer should be made of aluminium if it is possible to obtain a strip of this metal in sheet; if not, brass may be used. Fig. 10 shows the pointer in plan and section. Work the point down as thin as possible and paint it (the end) black. Fit on over the boss on the front side of the brass pointer hub and fasten as the needles were. The whole may now be placed on the spindle and as nicely balanced as the armature was. The scales are cut from copper, on a radius of a 10-inch circle, forming an arc of 120 degrees. Brass will do, but do not use any metal that will magnetize. The stock should be 1-16 inch thick. Finish down the face smooth, drill ⅛ inch screw hole in each end, as shown in Fig. 11A. The face should be given four coats of white enamel and baked in steam heat. If the builder cannot readily procure the enamel, white paint will answer and will not require baking. The supporting studs and washers, shown in Fig. 12A, B, C, are turned from brass. The hole at D is tapped out for the 6-32 screws holding the scale in place. The washer B is drilled at three points, E, to take the little 3-32 inch brass wood screws. The post, A, is riveted into

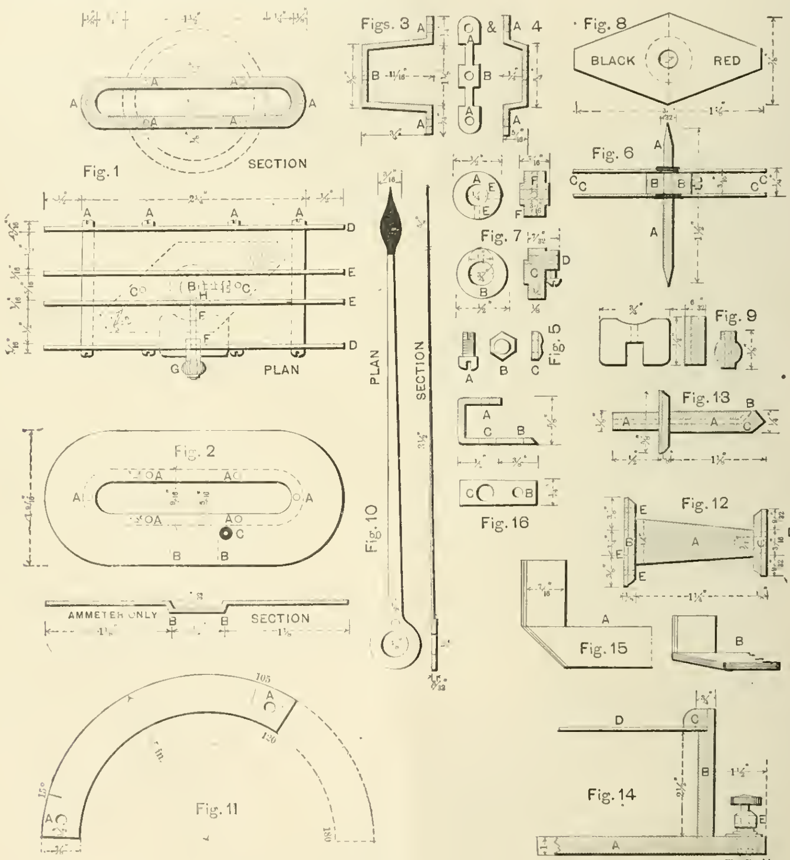
both washers. Two fibre posts, as shown in Fig. 13, are drilled up through their length, from the under side or end, but not going clear through the top end; let the hole, A, stop at the point, C, and here be intersected by the hole, B, drilled in through the side quite near the end. In case the two coils are connected in multiple, a second hole should also be drilled through the side, lower down, and half an inch above the washer, as at B. A thread is cut on the bottom end and a washer interposed between the hub on the post and the back of the case.

In making the boxes or cases, the writer believes that the builder should follow his own tastes as to design and finish. The cases on the models are made of mahogany, ¼ inch stock, the outside washed in a weak solution of potash to give the wood a darker hue, and the inside stained, or properly, dyed, to imitate ebony, by using several alternate applications of hot solutions (separate, of course) of logwood and copperas. This gives a beautiful rich, dead-black finish, a good imitation of unpolished ebony, making an excellent background to show up the works of the instruments. The frame front, or cover, is 8½ by 6½ inches inside measure, 2½ inches deep under the glass, with the under edge felted. It can be hooked on to the back, or hinged as the models are, and fastened with a lock to check the curious. The back should be made in alternate layers, with the grain of the wood running at right angles, and glued up; or, if in one piece, have the ends cleated and tongued and grooved on to prevent all possibility of warping. This should be fully 1 inch thick. Fig. 14 shows a section of the case: A is the back; B, the bottom side of frame; C, quarter round molding; D, glass; E, binding post, which can be purchased at any of the supply stores. The little feet which hold the whole mechanism to the wooden back are made of 1-16 inch brass, as shown in Fig. 16, and screwed to the core outside and next to the feet of the back side hanger; A shows the screw hole; C, drilled larger, admits the screwdriver to turn this screw, and B is for the wood screw.

The entire instrument should be put together before the wire is wound on, to see that all the parts fit and work as they should. Feeling fully satisfied with the work so far, the works should be all removed from the core, with the exception of the collars, and laid carefully away in some covered box. A hole will have to be drilled through the two middle washers, on the rear side, with a ⅛ inch drill plugged with fibre, finished off smooth with the brass collar, then a 1-32 inch hole drilled through the centre of the fibre, as shown in Fig. 2C, if the two coils are to be connected in series.

The windings of our instruments are extremely simple. Taking the voltmeter first, we must have sufficient wire on its core to a little more than equal the resistance of one of the incandescent lights in the circuit, or have a resistance coil of fine German silver wire in series with the wire in the magnet coil. The resistance of the model is about 24.9 ohms, which is not sufficient for from 50 to 60 volts, and a resistance coil must be put in. If the two meter coils are in series this resistance should equal about 90 feet of No. 30 German silver wire; if the coils are connected together in parallel, about 60 feet of No. 28 of the same will be sufficient. This wire should be coiled into open spirals and strung between slate supports outside of the meter case, as it will heat some. (See cut of the writer's instruments on page 17, The Electrical World, July 7. In this voltmeter the resistance is in 6 coils, 15 feet each, above the case protected by a wire netting cover.)

We shall need a quarter pound of No. 30 B. & S. gauge, commonly called 10 mil wire, the diameter being 10-1000 of an inch. We will not use quite all this wire, but it is safe to have a little more than what is actually required; single-covered (cotton) copper wire will do all right, if the beginner will use care in winding it on. Collars of the leather board should be fitted on over the core snug



Details of Volmeter and Ammeter.

and rest close up against the washers, with a thickness of asbestos paper wrapped around the core. The needles must swing around from the left over to the right, in order to carry the pointer over the scale in the right direction to read the E. M. F. of the current.

(To be continued.)

The Best Proportions of Armature Diameter and Length in Dynamos and Motors.

BY M. H. JOHNSON.

The bearing which the ratio of the diameter and length of the armature have upon the material used in the construction of a dynamo does not seem to have received the attention it deserves considering its importance in the designing of electrical machinery.

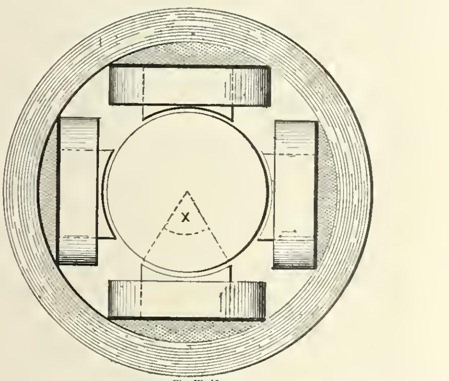
In order to determine the matter and reveal the best proportions for the armature, it is necessary to investigate the variables in the machine dependent upon its output and their relation to the dimensions of the armature.

In the types of machines usually met with there are four principal variables. They are the magnet core and yoke, the armature core, the field wire, and the armature wire. These quantities are not truly derived from the diameter and length of the armature, but are complicated functions dependent upon each other and constants for the material as used; but it is not the purpose of the writer to go into formulæ which are chiefly of use to students. So, for the sake of simplicity, it is assumed that the output of a dynamo is at all times represented as $W = D^2 S R a$.

Where

D = diameter of armature;
S = spread of armature;
R = revolutions per unit of time;
a = constant depending upon units and material used.

To further simplify the matter let us consider a four-pole, shunt-wound machine having magnet cores without polar extensions and



BEST PROPORTIONS OF ARMATURE DIAMETER AND LENGTH.

pole pieces which span a fixed arc of the armature circumference = X, such a machine as is shown in the accompanying illustration. In dynamos of this type cross sections of the frames at right angles to the armature shafts of machines having different armature diameters are similar geometric figures whose areas are proportional to the square of their perimeters or diameters. So the material of this part of the magnetic circuit is proportional to D^2 times S, and economy in the use of iron is not to be effected by altering the ratio of D and S in a machine, for the intensity of induction, speed, etc., being the same, the weight of iron or steel varies as the output.

In a machine of this type, the number of conductors on the armature (or number of turns) is proportional to $\dfrac{\text{Volts}}{a\,R\,S\,D\sin\frac{X}{2}}$ and if the volts, speed and X are constant, the number of turns is proportional to $\dfrac{1}{S\,D}$. The length of one turn is proportional to $2\,S + b\,D$ (b is a constant depending upon the winding).

Now if D and S are altered in a machine of given output so that $D^2 S$ = constant, and the armature resistance be kept constant, the area of the conductor must increase as the length, and the weight as the square of the length. Hence these relations:

Length of conductor proportional to $(S + D)\dfrac{1}{D\,S} = \dfrac{1}{D} + \dfrac{1}{S}$
Area " " " " $(S + D)\dfrac{1}{D\,S} = \dfrac{1}{D} + \dfrac{1}{S}$
Weight " " " " $\left(\dfrac{1}{D} + \dfrac{1}{S}\right)^2$

In a machine of this character, the area of the air gap is practically equal to that of the magnet core, and its length varies approximately in proportion to the diameter of the armature, as does also the metallic part of the magnetic circuit; therefore the ampere turns required to excite the field vary as the diameter of the armature. Assuming the resistance and current in the magnetic coil to be constant, the proportions of the coil are these:

Number of turns proportional to	D
Length of one turn " "	$D + S$
" " wire in coil "	$D^2 + D\,S$
Area of conductor " "	$D^2 + D\,S$
Weight " " "	$(D^2 + D\,S)^2$

From the foregoing we get an idea of the dependence of the weight of copper in a dynamo upon the armature dimensions. In the particular case here taken,

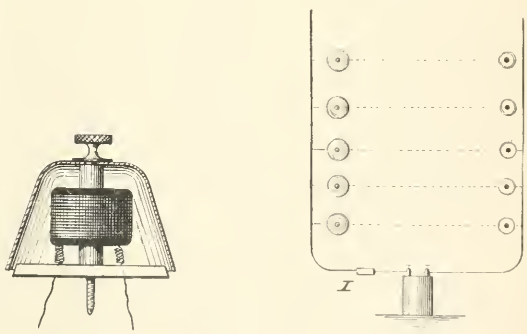
$$\text{Weight of armature copper } f\left(\frac{1}{D} + \frac{1}{S}\right)^2$$
$$\text{" " magnet " } f\left(D^2 + D\,S\right)^2$$

It will be noticed that these are both functions which reach a minimum value at $\dfrac{S}{D} = 2$. So it is apparent that $\dfrac{S}{D} = 2$ is the best ratio to use in proportioning the armature for the style of machine upon which this determination is based. These values do not represent the relations in machines of all other types, but a little study will reveal them, and the proportions will be found correct, except in extreme cases.

Harmonic Call Bells.

BY S. D. MOTT.

I have frequently been asked if it is not possible to do away with the noisy clapper-stroke bell which grates so harshly on many ears, and why some one does not devise and introduce a better substitute for it than the buzzer, which makes the nervous ones in our homes jump when it signals by the suddeness of its noisy clatter, adding its quota to the general din of many modern appliances and conveniences. When loudness as a warning of danger or alarm, etc., is not a prime requisite it would certainly seem that an agreeable musical tone would be far preferable in homes, banks, and banking houses, hospitals and like institutions where quiet is desired.



FIGS. 1 AND 2.—HARMONIC BELL AND DIAGRAM OF CIRCUIT.

I believe to a majority of commercial users of call apparatus such a system would be appreciated and would be given preference.

Acting on the hint I herewith show sketches of a certainly simple, and inexpensive, and possibly useful, harmonic system of signalling.

The sound producer or resonator may be fashioned bell shape, this is, fastened to one extremity of an electro-magnet, to the other extremity or pole of which is fixed rigidly an armature. The bell is made of magnetic material and serves with the armature, also of magnetic material, to nearly close the magnetic circuit. (Fig. 1).

It is evident now to those acquainted with the general physical

principle of harmonics that if an alternated or interrupted current be used having the same rate of vibrating impulses as the musical pitch of the resonator, or an octave thereof, the bell will sound its note on the closing of the circuit through the magnet coil.

The system, though based upon a rather delicate principle of operation may, I think, be roughly made after being accurately planned like many familiar devices in commercial use.

Such calls may be made highly ornamental, easy to enstall, inexpensive and indestructable, having no clapper or moving parts.

Fig. 1, shows a complete bell, consisting of bell, in section, armature core, coil and fastening screw, the whole furnished in any fanciful or ornamental design.

Fig. 2, is a diagram of a call connection arranged in parallel circuit, and showing in the battery circuit an interrupter I, properly proportioned and adjusted to the requirements of the bell.

When one bell only is required, the push button may be constructed to act as the interrupter or alternator of the battery current.

If operated with a suitable magneto device, no buzzeror battery is required, but only the magneto and push button to each bell circuit would be necessary. If a magneto of sharp snappy impulse and changable period were used on a line of bells run in series and having varying tones, it would be in an operator's power to cause any particular bell to respond when the magneto current reached the note of the particular bell selected, by varying the speed of the magneto or otherwise causing a uniformity and equality of electric pulsation, with acoustic vibration; in a word, when the acting and responding device were in concord.

Rope Driving—XII.*

BY J. J. FLATHER.

It has been previously stated (see The Electrical World, Oct. 21, 1893), that where rope driving is used the loss at the engine in friction may be taken in a general way as about 10 per cent. of the rated horse power of the engine, that an additional 10 per cent. is absorbed by the shafting, and that from 5 to 8 per cent. may be attributed to losses in the rope itself, due to resistance to bending, wedging in the grooves, differential driving effect, and creep, all ot which affect the loss to a greater or less extent.

According to the accepted laws of friction we should expect that with an increased load on the engine the friction would be increased in direct proportion to the load, but in nearly all experiments to determine the friction of steam engines we have the anomaly that the work necessary to overcome friction is practically constant, and, in fact, in many cases it is a little greater when running without load than when the engine is fully loaded.

Although it may appear paradoxical, it is probable that the ordinary laws of friction obtain here as in other cases of sliding and rolling contact, but instead of having a constant coefficient of friction for the surfaces in contact, the coefficient may be considered as a variable depending upon the degree and distribution of lubrication—with increased loads on the engine the relative position of the elements of the bearing surfaces is changed to a greater extent during each revolution than with lighter loads, owing to an increased momentary fluctuation, and thus it is that a better distribution of the lubricant is maintained; it is also probable that on both sliding and rotating pieces where the pressure or direction is reversed a pump-like action or suction is produced by the very slight distortion of the surfaces, in which case we should expect not only a better distribution, but also a greater consumption of the lubricant if this action is sufficiently intense. Whatever be the cause, it is safe to assume that as the load increases the coefficient of friction decreases, so that at all ordinary speeds the internal resistance of the engine may be considered sensibly constant, in which case the so-called friction card of the engine represents practically the friction of the machine when fully loaded—the indicated power without load being sensibly the measure of the wasted work of the engine when in operation under load of whatever amount.

That is, the engine friction is independent of the load and is a function of the characteristic of the engine itself, of the speed of piston and rotation, and, to a slight extent, of the steam pressure, and of the method of steam distribution, so that while we may speak of the friction as being a certain percentage of the horse-power of an engine, it must be understood to refer to the rated indicated horse-power: at less than rated power the percentage of loss due to friction will be greater and at maximum power the per centage will be less. This is shown by way of illustration in the following table, which is taken from a paper presented by Prof. Thurston before the American Society of Mechanical Engineers in 1886.*

TABLE XII.—FRICTION PER CENT. UNDER VARYING LOADS.

Revolutions per Minute.	Steam Pressure.	Indicator Horse Power.	Friction Horse Power.	Friction per cent.
232	50	7.41	3.35	45
229	65	7.58	2.60	34
230	63	10.00	4.00	40
230	73	11.75	3.65	32
230	75	14.02	4.02	28
230	80	15.17	3.17	21
230	75	16.86	2.86	17
230	75	28.31	3.36	11.75
229	60	33.04	3.16	9.5
229	58	37.20	2.34	6.3
229	70	43.04	3.19	7 4
230	85	47.79	2.75	5.8
230	90	52.60	2.60	4.9
230	85	57.54	2.54	4.4

This engine, a "Straight Line," was 8 inches in diameter of cylinder by 14 inches stroke, it had a balanced valve with stroke varying from 2 to 4 inches according to position of governor and eccentric, a fly wheel 50 inches in diameter weighing 2,300 pounds. Its rated load was 35 to 40 horse-power.

Examining the above table, it will be seen that the friction of the engine varies somewhat with varying steam pressures and total power, but in such a manner as to indicate the controlling cause, as, for instance, imperfect lubrication, to be irregular in action, and, possibly, to some extent, due to errors of observation and to accident. The average friction horse-power is 3.11-h. p., and the variations from this value are distributed throughout the whole series, showing that the work necessary to overcome the friction is practically constant and independent of the load. The friction of this engine is extremely low, as at its normal rating the percentage of loss is less than 7 per cent. According to D. K. Clark† the frictional resistance of steam engines varies from 8 to 20 per cent. of their normal indicator h. p.—the size of engines experimented upon ranging from 13 to 350-h. p.

In recent tests of American engines it has been shown that with first-class workmanship and balanced valves the percentage of loss at normal working load has been kept down in some engines to 6 per cent., both with Corliss and with high speed single cylinder automatic engines, but this is exceptional and we may expect ordinarily that the frictional resistance will vary from 8 to 13 per cent. of the normal load.

Compound engines of the better class should not absorb more than about 10 per cent., and triple expansion engines no more than $12\frac{1}{2}$ per cent. under full load.

For small engines, either single or compound, there is probably little difference between the internal resistance, whether geared with ropes or flat leather belts, for the weights of fly-wheel and grooved pulley and the diameter of shaft would be essentially the same in each case. With larger engines, however, the belts would require a wider-faced fly-wheel, which, on account of the greater distance between bearings, would necessitate a larger shaft and hence increased journal triction. Assuming the same weight of wheels aud speed of rotation with the rope driving, the speed of the rim will be greater and a somewhat lighter pulley may be used to insure the same degree of steadiness in running; moreover, the elasticity and recoil of the ropes act in the same manner as mass in the rim, and for this reason a lighter wheel may be used with rope driving provided the construction is such as will permit it; moreover, in many cases the ropes are delivered from the fly-wheel in a nearly vertical direction, so that a certain portion of the weight on the bearings is neutralized by the upward pull of the ropes. The journal friction is therefore presumably less in the larger class of engines employing ropes, when compared with those using belts; the difference is, however, not great, and since the actual resistance in any case is also dependent upon peculiarities of type and construction, the lower values of engine friction previously given, viz., 8 to 10 per cent. of normal horse-power, may be considered to hold good for rope driving plants of medium size, while 9 to 12 per cent. of the normal horse-power may be taken as suitable for the larger class of engines running under favorable conditions.

* For the last section of this article see The Electrical World of April 28, 1894.

† Thurston Trans. A. S. M. E., Vol. x, p. 110.

* Trans. Vol. VIII. p. 90.

† The Steam Engine, Vol. II, p. 616.

In the ordinary transmission of power by shafting we find the shaft loaded with pulleys and the power taken off in varying amounts throughout its entire length—it is unusual except in short lengths to receive the power at one end and transmit it at the other. Moreover, in long shafting the head or receiving shaft is usually situated midway between the ends and the power distributed more or less uniformly from this head shaft to either end; therefore, in estimating the power absorbed by friction in ordinary mill or factory shafting loaded with pulleys, the previous formulas do not apply, as these relate only to those cases where power is taken off at the end of the shaft.

The conditions of practice as we find them in actual transmissions are so various that it is difficult to lay down any general rule by which the power absorbed by friction may be determined—the number and weight of pulleys and couplings, the intensity and direction of belt pull, the condition of bearings and their lubrication, all affect the amount of work lost in friction.

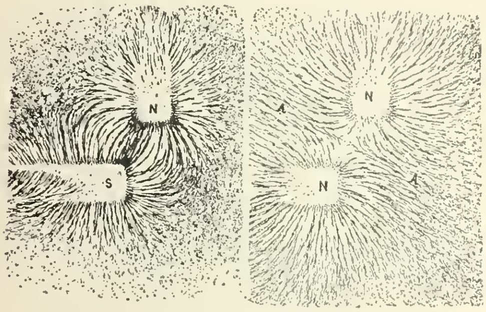
(To be continued.)

Dynamo-Electric Machinery—VIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Fig. 38 illustrates the flux distribution attending the approach of what are called unlike poles. Here the ether streams, we assume to issue from N, take the paths indicated in entering the magnet S.

Fig. 39 illustrates the flux distribution attending the approach of what are called like poles. Here the hypothetical ether streams

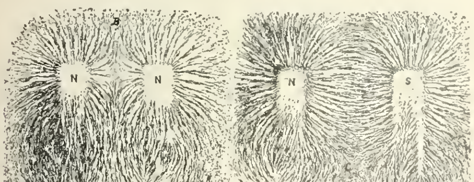


FIGS. 38 AND 39.

issuing from N, N, impinge, as shown, and produce a neutral line A A, corresponding to slack water in the hydraulic analogue.

Fig. 40 shows the distribution of flux in the case of two straight bar magnets laid side by side with like poles opposed. The imaginary ether streams again oppose and the neutral line B B, is produced as shown.

Fig. 41 shows the distribution of magnetic flux in the case of two straight bar magnets, laid side by side, with unlike poles opposed. Here, according to hypothesis, some of the ether streams issuing from each magnet, pass back through the other magnet, the



FIGS. 40 AND 41.

remainder closing their circuit in the air outside. A curious central region between the magnets, bounded by curves resembling hyperbolas is shown at C, where, by symmetry, no ether motion penetrates, and thus corresponding in the hydraulic analogue to calm water.

Fig. 42 shows the distribution of flux over the surface of what is commonly called an anomalous magnet, that is a magnet having two similar poles united at its centre; or, in other words, having two

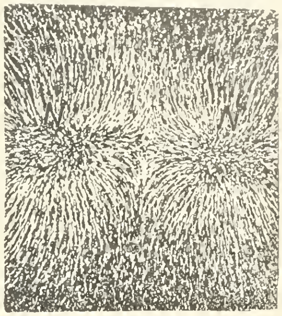


FIG. 42.

separate magnetic circuits. Here the distribution of flux is similar to that in Fig. 40, where like poles are approached.

40. Having given the M. M. F. in gilberts, the flux which will be produced by a magnetic circuit depends upon the disposition and nature of that circuit. For example, it is not to be supposed that the flux produced by the 12 ampere-turns (15.084 gilberts) in

FIG. 43.—RIGHT-HANDED HELIX OF 12 TURNS CARRYING ONE AMPERE.

the right-handed coil or helix of Fig. 45, by one ampere and twelve turns would be exactly the same either in magnitude or distribution as the flux from a single turn carrying 12 amperes, although the M. M. F. would be the same in each case. Just as in the case of an electric circuit, the current produced by a given E. M. F. depends on the resistance of the circuit, so in the case of the magnetic circuit, the magnetic flux produced by a given M. M. F. de-

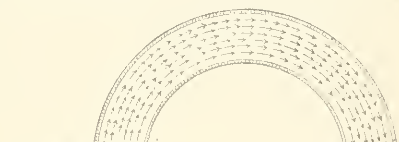


FIG. 44. — SECTIONS OF WOODEN RING UNIFORMLY WRAPPED WITH INSULATED WIRE CARRYING A CURRENT.

pends on a property of the circuit called the magnetic reluctance or simply its reluctance.

Magnetic reluctance, therefore, is a property corresponding to electric resistance, and is sometimes defined as the resistance of a circuit to magnetic flux.

41. The reluctance of a circuit is measured in units called oersteds. An oersted is equal to the reluctance of a cubic centimetre of air (or, strictly speaking, of air-pump vacuum) measured between opposed faces. Unlike electric resistance, the reluctance of

all materials, except the magnetic metals, is practically the same.

Having given the reluctance of a magnetic circuit and its total M. M. F., the flux in the circuit is determined in accordance with Ohm's law; that is $\Phi = \frac{\mathfrak{F}}{\mathfrak{R}}$ where Φ, is the flux in webers, $\mathfrak{F}$ is the magneto-motive force in gilberts and $\mathfrak{R}$ the reluctance in oersteds. It may be afford assistance to contrast the well-known expression—

amperes $= \frac{\text{volts}}{\text{ohms}}$ with the corresponding magnetic expression

$$\text{webers} = \frac{\text{gilberts}}{\text{oersteds.}}$$

42. The unit of magnetic flux is called the weber, and is equal to the flux which is produced by a M. M. F. of one gilbert acting through a reluctance of one oersted, corresponding in the above expression to the ampere, the unit of electric flux, which is that electric flux or current that is produced by an E. M. F. of one volt though a resistance of one ohm. For example, if an anchor ring of wood, such as is represented in Fig. 44, have a cross section of 10 sq. cms. and be uniformly wrapped with insulated wire, then when the current passes through the winding, the magnetic circuit will be entirely confined to the interior of the coil or solenoid, and no magnetic flux will be perceptible in the region outside it. This is the only known form of magnetic circuit in which the flux-paths can be confined to a given channel. These flux-paths are all circular, and possess the same intensity around each circle. If the mean circumference of the ring be 60 cms., the reluctance of the magnetic circuit will be approximately $\frac{60}{10} = 6$ oersteds, just as in the similar case of electric resistance. If the number of turns in the winding is 200, and the exciting current steadily maintained at four amperes, the M. M. F. in the magnetic circuit will be 800 ampere-turns, or 1005.6 gilberts. From this the total flux through the ring will be $\frac{1005.6}{6} = 167.6$ webers.

(To be continued).

The Earth as an Electrical Conductor.

BY JOHN HENRY HOLT.

That the earth could be used to conduct electric currents was discovered by Stemheil, at Munich, in 1837. While experimenting upon the Nüremburg-Fürthet Railway to ascertain whether or not the track could be used as one of the conductors of a telephone circuit, he noticed that the current would pass from one rail to the opposite one, traversing the intervening earth, which at once led him to believe that he had discovered a most excellent conductor, the resistance of which was practically nil. As he thought, so has been the common belief among scientists generally, until recently, when engineers especially interested in electric railway work have turned their attention to the subject, and have proven the fallacy of such a theory.

It is no more than natural to suppose that a body having such an immense cross section should offer little or no resistance to the current. But we must remember that we are not, as is the case with a copper wire, dealing with a homogeneous mass of good conducting material. Stratified, contorted and twisted; here a metallic vein, a good conductor; there one of slate or rock, sometimes in horizontal beds, sometimes forming vertical walls of highly insulating material, together with the many subterranean watercourses —all go to make the earth a very complex subject to deal with.

About two years ago it was undertaken, at the Alabama Polytechnic Institute, to transmit power from an Edison generator on the college campus to a motor situated some 3,000 feet distant, for the purpose of operating the cotton gin, threshing machine and other power machinery at the experiment station. In undertaking this work it was decided to use the earth as a return, in the belief that by such an arrangement the cost of copper would be reduced just one-half. The result was that not sufficient power could be gotten at the motor to operate the lightest machinery at all successfully. There was evidently an immense drop in the line, which at once proved the plan of using the earth as the return impracticable.

Believing the great drop to be due to the employment of the earth, the professor under whose supervision the work was done tested for the resistance of the same, using the Wheatstone bridge, with direct current. He found it to be exceedingly high. Having had the following problems submitted to me, I undertook an investigation of the same portion of earth: (1) To find the resistance of the earth between the two terminal stations; (a) with earth plates used as grounds; (b) when placing the earth plates in wells at terminal stations; (c) when using ground and well plates in parallel. (2) To find the resistance between one terminal station and the successive intermediate stations, thereby showing the relative conductivity of the different strata. (3) How the resistance is affected by the polarization of the earth and well plates. (4) Is the resistance altered when using alternating currents? If so, how and to what extent?

Ground connections were made, one near the power house on the college campus, which hereafter will be designated station (A), and another at the farm, shown on the left in the figure and designated (B). These stations are, by measurement, 3,000 feet apart. Connection with earth at each was made by using large earth plates. They consisted, one of copper and the other of tin; were seven by two feet, and to each was soldered a No. 0000 bare copper wire. Each plate was placed in a pit eight feet long, two feet broad and six feet deep, and around the plates was well packed iron filings and charcoal, in addition to which some pieces of scrap iron were thrown in before the pit was filled with earth. Besides the earth plates, and at a distance of about twenty feet to the right and left respectively of each, is a well, in which, at the time of the test, the water stood about four feet deep. In each well was placed a thin sheet iron plate, measuring two and a half by three and a half feet.

(To be continued).

Engineering Education and the State University.*

BY WM. S ALDRICH.

Engineering education is an education for a profession. As such its first requirement is a liberal education, given by the pursuit of those studies affording mental discipline while developing a love of learning for its own sake and capable of imparting an added grace in the exercise of future accomplishments. The professional education follows, and distinctively technical features are to be combined with practical work of an educational value. This will be found in selected exercises and activities from among those required in professional life, in office, field, shop and laboratory.

Will such engineering education thrive in a university atmosphere? University presidents and renowned engineering professors have advised against its introduction into the university curricula. In the United States, education for engineering as a profession has not only been recognized as entitled to, but has actually received and been correspondingly benefitted by, a university environment, quite as much as in the case of law and medicine.

Federal and state aid to higher education received early recognition in the educational history of the country, chiefly in providing for academic training. Technical education received its most encouraging aid from private benefactions till its national endowment by the Land Grant Bill of 1862. The "Colleges of Agriculture and the Mechanic Arts," established pursuant to the provisions of this Bill, mark the beginning of a new period and of a peculiarly American development of national aid for promoting scientific and industrial education. Agricultural education languished, however; instruction in the mechanic arts had not yet developed into a science; and its incorporation into such colleges was somewhat incomplete until endowed schools led the way; meanwhile, scientific, classical and military instruction carried the day. It will probably be admitted that this Bill stimulated private endowment fo technical schools quite as much as it directly benefitted engineering education.

The Moriill Bill, of August 30, 1890, recognized engineering education and made possible some form of its development in all of the Land Grant institutions. Aside from instruction in agriculture and the English language, the remaining branches specified in the Bill are: "the mechanic arts, and the various branches of mathematical, physical, natural and economic science, with special reference to their applications in the industries of life, and to the facilities for such instruction." It seemed destined to endow and maintain courses in the mechanic arts, to support engineering laboratories, while some portion of the Morrill Fund might be allotted for the maintenance of instruction in the newly-acquired branch of experimental engineering. It came at a time when most urgently needed to strengthen the old courses and assist in establishing new and rapidly growing engineering courses, such as in electrical engineering. There were only two ways to realize "the more complete endowment and support" guaranteed by this Bill to all of the original Land Grant institutions: (1) by increasing the salary account; (2) by providing additional facilities for instruction, such

*Abstract of a paper presented at the Brooklyn meeting of the Society for the Promotion of Engineering Education.

as apparatus, machinery, text and reference books, stock and material.

The salaries of certain Chairs, formerly paid out of State appropriations, have been found to be legitimately payable out of this Morrill Fund, by reason of the instruction provided for by the occupants of those Chairs. The educational institutions of such States do not receive "*more complete* endowment;"—it is the State treasury or some other institution which receives it. The appropriation is increased from Washington but decreased from the State Capitol to the extent of the salaries so paid. In the same year that this was done hundreds of thousands of dollars were appropriated by one and the same State for an Insane Asylum! Pounds of cure: ounces of prevention.

Distinctions of race or color, made by any State in the admission of students to its Land Grant institution will require that State, by the provisions of this Bill, to make "a just and equitable division of the funds to be received under this act between one college for white students and one institution for colored students." This means two faculties, double equipment and a separate establishment throughout. Such States need for developing engineering education all that this fund will provide, especially that parasitism in the matter of salaries has already developed in some of them.

Engineering education is much less promoted by the Land Grant Bill, of 1862, than by the Morrill Bill, of 1890, for two principal reasons: (1) the classical and military instruction, provided for by the former, are excluded by the latter; (2) instead of the unequal permanent national endowments of the former, there is an equa annual appropriation given to each State by the latter. The effect of this favorable difference has been already felt in many of the States, and it has stimulated many additional private endowments to technical schools.

The least that the State could do in accepting this federal aid was to meet the simple requirements of the law, to purchase, erect and maintain suitable buildings in which the instruction provided for by the General Government could be materialized. Besides this, however, the establishment of light, heat and power plants by some of the States in their institutions has rendered very material and needed aid. Formerly urged for business reasons, such as securing greater economy of installation, maintenance and supervision, it has become apparent that these power plants gather about them facilities for shop work and laboratory training in electrical, steam and hydraulic engineering. State pride and competition will enhance still further their great economic and educational value.

Agriculture and mechanic arts have been inseparably connected in the minds of statesmen, when planning and developing federal aid for such instruction. However, when it comes to the question of national endowments for the promotion of scientific research, statesmen are divided, as is shown by the act of 1887 appropriating $15,000 annually for the establishment and maintenance of agricultural "experiment stations," in all of the Land Grant institutions. The direct aid which these have rendered to scientific agriculture has scarcely been less than the indirect benefit to agricultural education. The rapid growth of experimental engineering within the last decade; its recognized value for the determination of engineering data; its incorporation into the professional courses for almost all American technical schools, bespeak a like consideration for engineering "experiment stations" or laboratories, in connection with all Land Grant institutions.

Such a State engineering laboratory would be of invaluable service in the promotion of engineering education in the institution with which it would be connected. Engineering practice throughout the State would be reciprocally benefitted. The duty of the State in protecting life and property from engineering casualities and negligence would receive attention commensurate with that now given by the agricultural "experiment station," to healthful foods, farm and dairy, sanitation and stock raising. The State's resources of materials for building and other constructive work, as well as fuels, prevention of waste and utilization of by-products, would receive careful investigation. It should be allowed the same immunities and granted the same privileges now enjoyed by the agricultural "experiment station" in properly charging for tests, researches, analysis and other scientific investigations. State aid should be given for the publication and interchange of bulletins, quarterly or oftener, adding as much to the value and permanency of the year's work in engineering as is now done in agriculture. Engineering literature, researches, data and precedents would thereby receive an amount of careful attention that it is almost impossible for individuals, corporations or manufacturing establishments to give. What has been accomplished already by private munificence in many of the above lines of engineering work in the shops and laboratories of a few of our leading technical schools, should be repeated, extended and made possible in all of the Land Grant institutions.

Engineering education receives more or less consideration in the following classes of institutions: (1) those dependent entirely upon State and federal aid; (2) those receiving private endowments in addition to State and federal aid; (3) those dependent entirely upon private endowments. For any particular branch of engineering in any one of these, the technical studies of the class-room will be found much the same, while the academic requirements differ widely. The kind and amount of practical work, in office, field, shop and laboratory, will vary greatly according to the nature and extent of the endowment. In no other kind of education will financial considerations enter to change so completely every condition and alter so entirely every product, as in engineering education.

The faculty organization for engineering education has three distinct stages in its evolution: (1) engineering teachers are members of one common faculty; (2) they are organized as an Engineering Faculty, similar to the Law and Medical Faculties which usually exist at this period of development; (3) the organization of the Engineering College within the university, with its Dean or Director, whose duties are related to this college as those of president to the university. The faculties of State institutions are much less stable than in endowed institutions. Aside from political causes, the reasons are obvious and well known. There are engineering ethics and equities in teaching as well as in the practice of the profession. The most efficient professional teaching can be done and the most highly developed product obtained by departmental organization of which that of the Engineering Faculty is the first step in the right direction. The Engineering College is a plan of organization falling into line with a form of university management which has been remarkably successful in other branches in European universities. In our State universities, engineering education admits of such an ultimate ideal, and some of them have already taken the lead.

The federation of all State Colleges and Universities into a National University, with its educational centre at Washington, would place such an institution in the very midst of the most favorable environment for the prosecution of that kind of educational work for which it came into existence. Senate Bill 3824 was thus reported upon by the Select Committee (March 3, 1893): "It provides for the establishment of a university of the highest type, resting upon the State universities and other institutions of collegiate rank as they rest upon the high schools and academies, a university whose facilities shall be open to all who are competent to use them; but whose degrees shall be conferred upon such only as have received a degree from some institution recognized by the university authorities; and whose several heads of departments are to have advisory and co-operative relations with the heads of Government Bureaus for the mutual advantage of the Government itself and the cause of universal science."

The "Sine Curve" Controversy.*

In our issue of July 6th, on page 258, we observed that a considerable number of manufacturers in America are advertising the possession of a "true sine curve" as a valuable feature of their alternators. We returned to the subject a fortnight later, and on July 20th, on page 319, made some further remarks on the subject. After these were in type, we found that our views received full confirmation from some experiments which are being conducted with special reference to the efficiency of transformers but which are not yet completed. The matter has now given rise to considerable controversy, but is being led off the original line into cases of power transmission by special types of machines. Last week we referred to some foolish remarks in an American electrical journal published in Chicago; but the matter assumed a more important shape when, on Friday morning, we received The Electrical World of New York, dated August 18th, and found therein letters from Prof. Houston and Mr. Kennelly, Dr. Louis Duncan, and from Mr. F. W. Dunbar, together with an editorial comment.

Our esteemed contemporary, The Electrical World, takes the matter very seriously.

"It is seldom that we find it necessary to disagree in toto with our esteemed London contemporary, the "Electrician"; but, notwithstanding the ability with which it has clung to its opinion as to the non-efficacy of the sine form of curves of alternating E. M. F., we have not been able to see anything but hopeless error in its views of this subject. In our issue of last week, and elsewhere in the present issue, several correspondents whose opinions have an authoritative value, confirm the views we have expressed and offer an accumulation of evidence, both theoretical and experimental, which should definitely settle the

* From the London Electrician, August 31 and September 7, 1894.

question. The very neat general mathematical demonstration of Mr. F. W. Dunbar complements the special deduction in Kennelly's Institute paper on impedance, while the other letters bring to bear an accumulation of evidence that takes away every vestige of ground for the opinion which they contest. From both the theoretical and the practical standpoint it can be considered as definitely established that the sine form of curves of alternating E. M. F. is the best, for the reasons that it involves less inductive drop and less iron losses in transformers, and is absolutely necessary in motor work to avoid deleterious reactions from the upper harmonics otherwise present. To these advantages may be added the further one recently referred to by us in commenting on some German experiment with alternating arcs, which is that for the practical working of such arcs the sine curve insures smoother operation of the mechanism and a minimum of noise."

Our readers may judge for themselves as to the advantages of sine curves for arc work from the German paper, of which we print the first half in our present issue. We refer to this paper elsewhere.

Our critics, in the majority of cases, have made two mistakes in regard to our statements as to the value of a sinusoidal electromotive force. Firstly, they have undertsood us to say that the sine curve is the *worst* possible for such a function; whereas all that we did say was that it is a waste of time and skill to try to get a sine curve, because the sine curve is by no means the *best* possible. Secondly they have failed to realize that our criticisms are of a perfectly general nature, relating to the inherent qualities of the various electromotive forces, and by no means referring to the performances of any one particular machine. It is true that we pinned our remarks upon some trials of alternate-current machinery by Dr. Duncan; but we merely did so in order to say that these trials by no means warranted the general conclusion that the sine function is the best. Reference to our note, on page 319, will show this to be the case. It is quite possible that a certain motor might have such idiosyncracies as would lead it to work better with a sine function than with an electromotive force of any other form; indeed, Dr. Duncan seems to have discovered such a motor. He says:

"As far as the matter in question is concerned, the statement of Mr. Scott, of the Westinghouse Company, made in the discussion of the paper referred to, is very much to the point. He instanced the case of a two-phase motor, which, when driven from a certain dynamo, heated badly and had a great deal more 'armature slip' than was expected. It was found on investigation that the curve of dynamo E. M. F., was irregular, and the third harmonic was prominent. Being supplied with the sine E.M. F. the same motor ran efficiently and satisfactorily. Nothing can be more direct than this evidence. Mr. Scott remarked that in such a motor the third harmonic tended to turn the armature in a direction opposite to the primary wave, the result being disastrous. Mr. Steinmetz, who champions the three-phase system, pointed out that the third harmonic would tend to revolve the armature of a three-phase motor in the proper direction. While this is true, the efficiency of this component would be small."

We shall refer to the third harmonic presently. As to the evidence, it is by no means direct; it only shows that one particular *non*-sine curve was worse than the sine curve, with one particular motor.

Our esteemed friends, Messrs. Houston and Kennelly, are at

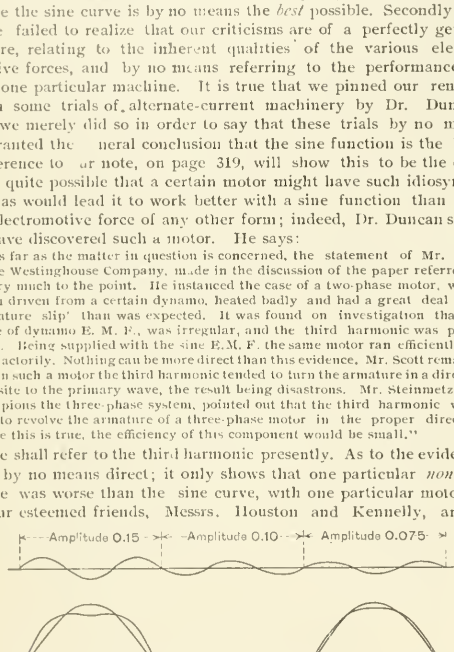


FIG. 1.—A SINE CURVE COMPOUNDED WITH ITS THIRD HARMONIC, WITH MAXIMA IN ANTI-PHASE: AMPLITUDE OF HARMONIC, 0.15, 0.1, AND 0.075, AMPLITUDE OF SINE CURVE BEING UNITY.

variance with us when we assert that this controversy is based upon the conclusions of mathematicians rather than of practical research. We quote from their letter:

"It is asserted that the reasons which have induced American designers to endeavor to obtain a sinusoidal E. M. F. in their alternators are mathematical rather than practical. This is by no means the characteristic of American electrical engineers, who are confessedly pre-eminently practical. In point of fact, the reasons, so far from being of a mathematical nature, are solely practical. It is known by observation that the loss of energy in the excitation of transformers is greater for non-sinusoidal than for sinusoidal E. M. F.'s, especially at high frequencies. It is true that the extra loss of energy through non-sinusoidal E. M. F. waves is usually not of sufficient importance to render a strictly sinusoidal E. M. F. of great value for merely lighting purposes. But for purposes of power transmission, deviations from the sinusoidal form of E. M. F. wave become deleterious, partly on account of the additional drop or pressure in the conductors transmitting the energy, partly owing to the additional loss of energy entailed in the transformers, but principally owing to the reactions set up in the induction motors by the virtual harmonics present in the sinusoidal form of E. M. F. whenever rotary field motors are employed."

Nevertheless, it is to the mathematics of Mr. Kennelly that Dr. Duncan and other adherents to the sine curve have referred us in support of their theories. Messrs. Houston and Kennelly make the mistake already referred to, of supposing that we are placing the sine curve at the bottom of the list.

It is vagueness itself to speak of comparisons between sinusoidal and non-sinusoidal curves, without naming exactly the components of which these latter are composed. There are non-sinusoidal curves which are vastly worse than the sine curve, and there are other non-sinusoidal curves which are decidedly better than the sine curve. Take, for example, Dr. Duncan's sine function with the third harmonic. If the harmonic is exactly in anti-phase with the fundamental, a condition of things shown in Fig. 1 will occur. The illustration shows that, with three different amplitudes, three different resultant curves are produced, every one of which has a less maximum than the primary curve. If the maxima of the two components are co-phased, however, the condition of things represented in Fig. 2 will take place. The resultant maximum will be greater than the maximum of the primary. For other phase relations between

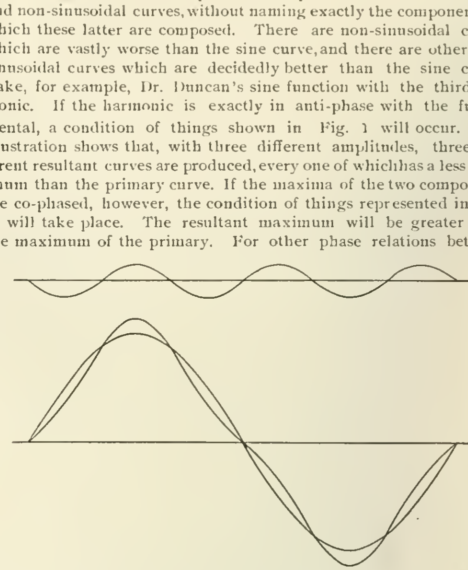


FIG. 2.—SINE CURVE COMPOUNDED WITH ITS THIRD HARMONIC WITH MAXIMA IN CO-PHASE: AMPLITUDE OF HARMONIC, 0.15.

the components, intermediate results would occur. Do our critics mean to say that the losses in an alternator, transformer, or motor would necessarily be greater with the flat-topped resultant curve in (Fig. 1), than with the fundamental sine curve? Do they insist that to get the best results it is necessary to avoid the flattened curve, as well as the peaky curve in (Fig. 2), and to get as closely as possible to the simple sine curve? We will grant them that the peaky curve will not best satisfy their wants; but we must insist that the efficiency of the flat curve is better than either of the others. In this connection we would refer our critics to the letter from Mr. Steinmetz,* which we published last week. Mr. Steinmetz says:

"The hysteretic loss per cycle in the transformer exclusively depends upon the limiting values of magnetism and will remain the same as long as these are the same. . . . If the wave of E. M. F. differs from sine shape, we can consider it as a fundamental sine wave with higher harmonics superimposed thereon, and then the wave of magnetism will also be a distorted wave, consisting of a fundamental sine wave superimposed by sine waves of triple, quintuple, etc., frequency. It is obvious now that if the triple harmonic wave of magnetism is superimposed upon the fundamental wave in such a way as not to increase its maximum value, the core loss will not be increased; but the amount of energy transformed is increased by the energy of the triple harmonic."

Finally, we would remark that since the flat-topped curve is the best for general distribution purposes, best for transformer and generator efficiency, and as good, at least, as any other for lighting purposes by glow lamps, and if we understand Herrn Rössler and Wedding aright, better than a sine curve or a peaked curve for arc lamps, it is therefore to the interest of makers to cultivate this type of curve. Herrn Rössler and Wedding, indeed, in the second part of their paper, for which we cannot find space this week, say, "Apparently it would be best to build machines whose curves approach the shape of Fig. 15."

This diagram, which we shall reproduce next week, is simply rectangular. That there are special cases where another type of curve is better adapted to the local conditions we are quite ready to believe: and we are also willing to recognize the existence of alternate-current plant which can only subsist on sine curves. But it remains yet to be shown that there is the smallest ground for believing the sine curve to be inherently the best and most efficient. This neither the able pen of Mr. Kennelly, nor the fallacies of Mr. F. W. Dunbar, nor the experiments of American electrical engineers, give any present indication of doing. While Dr. Louis Duncan goes to one extreme and considers the particular case of his peculiar and fastidious motor, Mr. Dunbar takes the other extreme, and so anxious is he to generalize, that he abandons the consideration of the

*See The Electrical World August 25, 1894.

presence of iron, and bases his arguments on a mechanical analogy. The discussion of the behavior of iron-less transformers and motors may be interesting to mathematicians, and of use to some kinds of students; but the whole point of *our* case is the effect on the iron. After recapitulating our remarks, Mr. Dunbar writes:

"These criticisms, coming from the London 'Electrician' and entirely unsupported by any theoretical or practical evidence, are even more astounding when we consider the ease with which it may be shown that the most efficient rate at which electrical force may be applied to do useful work is the sine curve, and this without the necessity of discussing *individually* the 'intricate phenomena of alternating-current machinery.'"

He then indulges in some "iron-less" mathematics, and naturally arrives at the conclusion that where simple mechanical considerations of mechanics are concerned, a succession of simple sine impulses is the best. Having proved this he goes on to say:

"The sine curve of E. M. F., then, is the curve which will impart the greatest average momentum to an electrical circuit for a given average alternating force; that is, it is the 'best' curve for an alternating E. M. F. which is to be used to do useful work, for it is evident that all losses due to eddy currents, hysteresis, &c., &c., will then also be a minimum."

This conclusion is, we maintain, quite unwarranted.

Confidently as we maintain that a sine curve is not the best, and that a flat-topped curve is better, we must point out that the difference when reduced to £ s. d. is but a trifling amount. The experiments to which we have alluded agree well with those of Mr. Steinmetz, viz., that the iron losses in generator and transformer were about 10 per cent. greater with a sine curve than with a flat-topped curve. This flat-topped curve was not, so far as we are aware, designedly of that shape, and when the "best" curve has been obtained the difference will no doubt be greater. This week Mr. Steinmetz strengthens his former statements and our position by giving an example of a motor, in which the relative economy with the non-sinusoidal wave was as high as 13 per cent. His letter will be found in our correspondence columns. We do not, therefore, urge that the saving will be a large one. The matter is not one of vital importance; it is hardly worth having a demonstration in Hyde Park about it; but our original contention, that it is folly to struggle after a sine curve for general work, remains unshaken.

There was some ambiguity in part of our article on "The Sine-Curve Controversy" last week. We contend, with Mr. Steinmetz, that the flat-topped curve of magnetism is better than the sine curve. This means a peaked curve of volts. Our American friends, on whose side Prof. H. J. Ryan places himself, prefer the sine curve. When they speak of a sine curve of volts they assume, of course, a sine curve of magnetism also.

The Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—The discussion to which a recent editorial in the London "Electrician" has given rise, and which has been taken up with so much spirit by American engineers, is very interesting from the varied ideas which it has brought forth; as to the conclusions, I cannot see that they should be as absolute, whether in one sense or in another, as has been maintained.

The most prominent advantage of the sine form of curves of E. M. F. is that it permits results to be predicted with more precision than is possible otherwise. It is with an analogous end that recently the principle of articulations in stone bridges has been established, of which the calculation was formerly entirely problematical. In replacing the old form of alternator by an alternator with a sinusoidal form of E. M. F. calculations are, thereby given a real basis instead of an approached hypothetical one. Mr. Steinmetz states that calculations can be made upon the basis of an equivalent sine curve. Unfortunately this varies with the composition of the exterior circuit, and has, therefore, no practical bearing. There is no single sine curve always equivalent to the E. M. F. of an alternator when the latter is complex. The sine form of E. M. F. alone permits to be realized with success all the combinations involving reactance. The presence of higher harmonics may modify everything, not only in circuits where condensers are employed but also in others containing inductance apparatus, such as electromagnets. An arc lamp will not maintain its regulation when the form of the E. M. F. of its circuit is changed, and if we could always count on the sine form the regulation would be much more certain.

The danger from industrial currents increases with the presence of upper harmonics through the physiological effects being more grave on the one hand and on the other because the effects of capacity are more important and can no longer be compensated for exactly by inductances.

The harmonics reduce the efficiency of synchronous motors (at least if these do not present an E. M. F. of exactly the same form as that of the line, as Prof. Ryan has pointed out). Suppose a motor with an E. M. F. of the form E sin ωt is connected with a circuit whose P. D. is of the form

$$E_1 \sin(\omega\tau-\vartheta_1)+E_2 \sin(2\omega\tau\ \vartheta_2)+E_3 \sin(3\omega\tau-\vartheta_3)+\ldots.;$$

the first harmonic will alone give useful work, for the terms of the form

$$\int_O^T \sin\omega\tau + \sin(\eta\,\omega\,\tau-\vartheta)$$

are nul and, in addition, the upper harmonics absorb a considerable energy,

$$R\left[\frac{E_2^2}{R^2\times(2\omega L)^2}+\frac{E_3^2}{R^2\times(3\omega L)^2}+\ldots.\right],$$

R and L being the resistance and self-inductance, respectively, of the motor. This effect is very sensible in practice. I have seen, for example, a synchronous iron-core motor with a sine E. M. F. (système Labow) which, running unloaded, absorbed a current varying from normal to double according to whether the E. M. F. of the alternator employed had or had not the sine form.

Moreover, the upper harmonics have necessarily the effect of reducing the efficiency of all induction apparatus, transformers or motors, through augmenting the foucault currents. This effect is practically negligible in transformers, but it can become important in closed circuit motors. In the latter, indeed, there are produced as many rotary fields with increasing velocity as there are harmonics, the efficiency of the apparatus only being good for a speed in the neighborhood of synchronism. All the rotary fields of higher order are almost useless and the heating is augmented in both the primary and the secondary. Finally, well made alternators with sine E. M. F.'s are exempt from noise and humming.

Such are the advantages of the sine curve, but they should not be exaggerated. In the first place, the increase of efficiency to which it gives rise is in general quite small; it seems to me impossible to believe that a motor of 40 h. p. could become as inefficient as Mr. Kelly has stated on account of a departure from a sine E. M. F. The three-phased high tension generators of Oerlikon and of Brown-Boverie, which give good efficiencies, are very far from giving sine curve E. M. Fs., and these two firms have had an experience in three-phased currents dating well ahead of American companies. Besides, the question of efficiency is not always preponderant, as seems to be often thought; in many cases the desiderata to be sought are cheapness, mechanical solidity, and a constant voltage. (Alternators that easily couple are those having a characteristic but slightly inclined, which is the secret of coupling).

In the second place, but little advance is often made by the mere fact of having obtained a sine curve E. M. F., for many ulterior causes may modify the current and even the P. D. at the binding posts. Without speaking of hysteresis, I have tried an alternator without iron of which the curve of E. M. F. was a perfect sinusoid on open circuit but one greatly deformed with a closed circuit. Inversely, alternators with iron may give a sine current at full load even though their E. M. F. is not sinusoidal. I have published, for example, curves of this nature in La Lumiere Electrique, August 18, 1893. This follows from the harmonics being, so to speak, eaten by foucault currents and smothered by self-induction. It is, however, quite another thing when transformers are employed, for the form of the primary, E. M. F. is far from being reproduced in the secondary.

Moreover, the employment of sine currents in induction motors is only a visionary condition if the coils are not disposed in such a manner as to obtain a sensibly constant magneto-motive force, for otherwise there are produced harmonics which only disappear at the cost of considerable foucault currents in the armature.

Conclusion: The employment of a sine E. M. F. can never be injurious; it is always to be recommended with a view to precision and is often indispensable; in certain cases it assures an important superiority of efficiency; in others this superiority is practically negligible. Under very frequent circumstances, in particular where transformers are employed, the realization of a sine E. M. F. is absolutely visionary, ulterior causes deforming the secondary in such a manner as to render most often entirely useless the efforts made to obtain the sine form in the generating machine.

Finally, it is necessary to know how to distinguish in what cases it is advantageous to endeavor to realize the sine form of E. M. F., and it is absurd to ridicule those who advocate its use under these conditions; the sine form should not, however, be held up as a panacea to which a superstitious respect should be paid. Here, as elsewhere, "in medio stat veritas."

A. BLONDEL.

Paris, France.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

The Voltaic Chain.—It is accepted as a law by many writers that the difference of potential between a metal and a solution depends on two constants: a constant for the metal and the cathion concentration of the solution; to test the validity of this Mr. Goodwin made experiments which are described in the "Zeit. feur Phys. Chem.," vol. 13, page 577, and abstracted in the Lond. "Elec. Rev.," Aug. 31; he concludes that the law which these experiments were designed to test is valid.

Alternate Current Resonance.—A paper by Mr. Wilson is published in the Lond. "Elec.," Aug. 31; it constitutes an experimental verification of one or two familiar problems in the theory of alternating currents.

Discharges Through an Orange.—According to an illustrated article in "La Nature," July 24, if a large battery of Leyden jars is discharged through an orange in the direction of its natural axis the whole orange will be illuminated, resembling an incandescent mass; if the discharge is passed perpendicularly to this axis the spark will pass around the outside of the orange and not through it.

Electro-optics.—A brief paper by Dr. Kerr, on a fundamental question in electro-optics, is published in the "Phil. Mag." for July.

Dielectric Constants and Chemical Equilibrium.—The paper by Mr. Nernst from the "Zeit. feur Phys. Chem.," vol. 13, p. 531 is abstracted in the Lond. "Elec. Eng." and "Elec. Rev.," Aug. 31.

Hydraulic Analogies.—An illustrated paper showing how the action of electric currents may be demonstrated by water currents, is published in the "Elek. Echo," Sept. 1.

Starting an Arc.—A translation of the article mentioned in the Digest, Sept. 1, is published in part in the Lond. "Elec. Rev.,"Aug. 31.

Electrical Repulsion of Solutions.—The Lond. "Elec. Rev.," Aug. 31, contains a note on this subject.

MAGNETISM.

Molecular Theory of Magnetism.—A British Association paper on Hysteresis in a Rotating Magnetic Field, by Mr. Baily, is abstracted briefly in the Lond. "Elec.," Aug. 31. It is a deduction from Prof. Ewing's molecular theory of magnetism that in a rotating magnetic field the hysteresis should diminish at a high induction; the experiment described in the paper substantiates this deduction in a very complete manner. The paper is the subject of a long editorial, in which it is said to be a verification by experiment of a result which had been predicted as the consequence of the molecular theory; it thus furnishes the most convincing support that the theory could possibly have received; if the theory is correct it would lead to the conclusion that a piece of iron or steel revolving like the armature of a dynamo in a very strong magnetic field, should show no hysteresis and consequently require no expenditure of work to maintain its rotation; the experiment showed this to be the case.

Magnetic Shielding.—A Physical Society paper by Prof. Rücker, read almost a year ago, is summarised in the Lond. "Elec. Rev.," Aug. 31; he desires to find the best arrangement that can be made under specific conditions as to the allowable space and the weight of the shielding material; he also defines the relation between the shielding exerted by a number of concentric shields.

Magnetic Rotary Dispersion.—A paper by Mr. Moreau from the "Ann. de Chemie et Physique" for February, is mentioned in the Lond. "Elec.," Aug. 31.

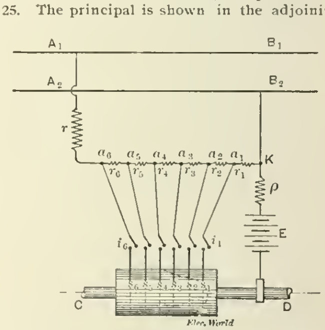
UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—The "Elek. Zeit.," Aug. 30, publishes a full description of the new unit of light and the apparatus for determining the same, which is hereafter to be used as the standard at the Imperial Institute at Berlin. The paper appears to be the same as that of which an abstract was given in the Digest, June 2, and of which an able discussion by Mr. Guilleaume was abstracted in the Digest, June 9 and 16. It was found that with the Violle standard results differing by 10 per cent. were obtained even when the greatest precautions were taken; neither the fusing point nor the point of solidification of the platinum gave a sufficiently definite temperature; the present method differs from the former in that a fixed temperature is obtained by means of a bolometer. The apparatus is fully described as is also the method of making the test; it is claimed that the reproduction of this unit is comparatively simple and that the errors are within 1 per cent. (Those interested in this unit should not fail to read the criticism of Mr. Guillaume referred to). The unit can be readily adapted to sources of different colors by adopting a different ratio in the temperature determination.

Photometric Units and Quantities.—In summarising the suggestions of Prof. Blondel, which were fully abstracted in the Digest, Aug. 11 and 25, the "Elek. Zeit.," Aug. 30, gives the following German terms for the various quantities: Lichtintensitaet for luminous intensity; lichstrom for luminous flux, beleuchtung for illumination, glanz for intrinsic brightness, belichtung for the quantity of illumination; (Fr. illumination); lichtmenge for quantity of light. The article strongly urges the adoption of the Hefner amylacetate lamp in preference to the Violle standard, on account of its great simplicity and of its sufficient accuracy.

Standards.—The English journals of Aug. 31, publish the official documents regarding the formal adoption by the English Government of the ohm, ampere and volt; it includes specifications for the use of the silver voltameter and the preparation of the Clark cell.

Method of Recording Current Curves.—An Academy paper by Prof. Blondel, on an electro-chemical method, is published in "L'Ind. Elec.," Aug. 25. The principal is shown in the adjoining cut, which



METHOD OF RECORDING CURRENT CURVES.

will explain itself; the recording drum which moves under the stiles must be driven synchronously with the alternator, either by means of a direct coupling or a synchronous motor; the resistances in the circuit to be tested, which in this case is the one connected to the two mains, must of course be non-inductive; formulas for the values of these resistances are given in the article.

Galvanometers.—Commenting on this paper of Prof. Schuster (see Digest, Sept. 8) the Lond. "Elec.," Aug. 31, points out that the basis of the formula is the magnetic force at the centre of the coil, but this, as Profs. Ayrton and Perry pointed out, gives erroneous results when applied to the case of a needle of sensible length; the error due to this would probably be large in Prof. Schuster's deductions; in such cases no calculations can be considered final if the want of the uniformity of the field is neglected; belief is expressed that the time is far distant when the sensitiveness given by Prof. Schuster will be approached.

Sensitiveness of Galvanometers.—In an article by Mr. Armagnat in "L'Ind. Elec.,"Aug. 25, he discusses and compares the various ways in which the sensitiveness or the constants of galvanometers are expressed; he proposes to call a coefficient of sensitiveness of a mirror galvanometer the deflection produced by a current of one micro-ampere, the scale being placed at a distance from the mirror equal to 1,000 scale divisions, the duration of oscillation of the movable part being one second without damping.

Electro-dynamometers Used as Wattmeters.—"L'Elec.," Aug. 25, contains an article by Mr. Meylan which is supplemental to the one abstracted in the Digest, March 10 and 31. Since the publication of that first article he finds that there is a slight error in one of the formulas and in the present article he gives the deduction of the correct formula; the error, however, changes nothing in the general conclusions arrived at in his first article regarding the measurement of the watts in a circuit in which there is a lag.

Harmonic Analyzer.—Papers by Prof. Henric, Mr. Sharp and Prof. Perry are published in the "Phil. Mag." for July.

DYNAMOS AND MOTORS.

New Kapp Alternator.—London "Electricity," Aug. 31, publishes an illustrated description taken from the London "Engineer."

TRANSFORMERS.

Transformer Systems.—An article in the Lond. "Elec. Rev.," Aug. 31, suggests that the numerous new automatic systems of switches for switching out transformers lose their value if the extra expense incurred is greater than the saving of the copper in the high tension lines.

ARC AND INCANDESCENT LIGHTS.

Spectroscopic Comparison of Different Lights.—In a paper by Mr. Muetzel in the "Elek. Zeit.," Aug. 30, he gives the results of some spectroscopic researches for determining the relative proportions of the different colors in the Auer (Welsbach) incandescent gas lamp, as compared with the incandescent and arc lights and the light from the sun. The comparison is based on lights which have the same intensity in the yellow part of the spectrum; the particular colors in question were reduced to the sam intensity by a Nicol's prism. The results, which are given in tables and in an interesting set of curves, are briefly as follows: The incandescent light has much more red than the Auer light, while in the latter the green is much more prominent; where warm colors are desired the incandescent light is therefore to be preferred; the arc light as compared with the Auer is poor in red rays but rich in blue and violet and it is also richer in green rays, but the latter is rich in red and orange rays and much poorer in the blue and violet; the Auer is therefore warm in comparison with the arc; in comparison with daylight the Auer light is yellow. The results, especially the curves, show that the arc light and sunlight are very similar, the former exceeding the latter both at the red end and at the extreme violet end, but is inferior to it in the rest of the spectrum; the arc light will therefore appear yellow when compared with sunlight.

Interior Illumination.—A paper by Mr. Nerz on interior illumination with arc lamps is published in the "Elek. Zeit.," Aug. 30. For small arcs he describes a method in which a small translucent glass screen, in the form of the frustum of a cone, encircles the carbon points where the arc is formed, appearing like a large incandescent mass; this is applicable only to small arc lamps; for large interiors he suggests throwing the light on the ceiling by using an inverted arc, the ceiling being painted a light color; he states, however, that this causes an unsteady burning of the arc because the crater of the positive carbon, which in this case is the lower one, acts as a receptacle for the ashes which, as they fall from the negative into the crater, cause an unsteadiness in the burning of the lamp until the ashes have been volatilized; he therefore concludes that the carbons as now made are not yet sufficiently pure to enable the inverted arc lamp to be used. He describes and illustrates a system in which the lower half of what corresponds to the globe is a reflector and the upper half a diffuser, the positive crater being as usual the upper one, a system which has met with great success in certain cases where diffusion was very necessary; in a table the areas are given which are illuminated by these lamps under various conditions. For very high ceiling rooms this system is not advantageous; as the light in that case is high above the eyes the direct system is preferable.

Lighting of Workshops.—"L' Eec.," Aug. 25, publishes an abstract of a paper by Mr. Dobson, in which he shows the advantages of the inverted arc lamp for the lighting of a cotton mill. The article appears to be the same as the one which was abstracted in the Digest, Nov. 18 and 25, 1893.

Incandescent Lamp of the Future.—In an article in "L'Ind. Elec.," Aug. 25, Mr. Claude discusses the possible directions in which the incandescent lamp may develop and concludes that it will probably be in the substitution of a refractive chemical compound for the carbon, such for instance, as the silicide of carbon; also in the use of a material which has two or three times the specific resistance of carbon.

Alternate Current Curves.—The paper from the German by Messrs. Roessler and Wedding on "The Potential and Current Curves of Different Types of Alternators and Their Influence on the Candle-power of Alternate Current Arcs," is published in a slightly condensed form in the Lond. "Elec.," Aug. 31 and Sept. 7. The paper was abstracted in the Digest, July 7, under "Current Curves for Alternators" and "Alternating Current Arc Lamps."

TRANSMISSION OF POWER.

Transmitting Power to Ships.—A device for connecting a moveable vessel with the shore by a cable capable of transmitting 200-h. p. is described and well illustrated in the Lond. "Elec. Rev.," Aug. 31; the cable is connected to a well insulated moveable joint at the anchorage of the vessel, from where connection is made with the vessel; the intention was to use it with a wave motor, but it can be used also for lighting lightships electrically from a generating plant on shore.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Accumulators Used with Motors.—The conclusion of the article by Mr. Darrieus, abstracted in the Digest last week, is published in "L'Elec.," Aug. 25. He gives the results of a number of discharges made with five cells in series and five like cells in parallel, all having been charged alike in series; a mean of six discharges shows that when connected in parallel there is a loss of energy of 13 per cent. as compared with the discharge in series; those that were connected in parallel were then connected in series and those connected in series were connected in parallel, after which a mean of eight discharges showed a difference of 23 per cent. (The compiler suggests that this difference is probably due to different rates of discharge of the individual cells in which case the difference in the discharges signifies a lower average capacity and not necessarily a complete loss of the energy unless the cells were charged in series with the other group, in which case they were simply overcharged). In practice he thinks this difference would be considerably greater; he cites a case in which accumulators were charged in parallel and it was found that one took 50 amperes while another took only 26; he concludes from this that accumulators should only be used in a single series. To run a motor at different speeds from accumulators the field should be separately connected with the batteries, in series with an adustable resistance; if still greater variations of speed are required, as for instance in railway work in which two motors are used, the two armatures may be connected in series or in multiple; when only one motor is used he suggests providing it with a double wound armature with two independent commutators and connecting these two windings in series or in multiple. A translation of almost the entire article, with the illustrations, is pubished in part in the Lond. "Elec. Eng,," Aug 31.

Series Incandescent Lighting.—The Goldston system is described and illustrated in the Lond. "Elec. Eng.," Aug. 31; besides the lamp base there is an additional support which presses against the lamp at the nipple in such a way that when the lamp breaks the support moves upward, thereby closing a contact which shunts the lamp; if the carbon is ruptured an arc will be formed which will break the bulb, which in turn will operate the shunt; the construction is exceedingly simple and the lamp is said to have worked satisfactorily.

Alternating vs. Direct Currents.—In commenting on a recent statement by Prof. Thompson that alternating currents cause less trouble from leaks than a continuous current of the same voltage, the Lond. "Elec. Rev.," Aug. 31, calls attention to the fact that with alternating currents the pressure to which the cable is subjected is not the effective but the maximum voltage, and it is the latter which should be taken into account in comparing alternating and direct currents of the same effective voltage.

Lightning in Central Stations.—The Lond. "Elec. Eng.," Aug. 31, records a case in which a central station was struck, the lightning passing from the building to the line and machines, and it concludes that it is very important that the station itself should be protected as well as the lines.

India.—An accumulator station at Bombay is described in the Lond. "Elec. Rev.," Aug 31.

WIRES, WIRING AND CONDUITS.

Electric Conductors for Coal Mines.—The Lond. Elec. Eng.," Aug. 31, describes briefly some safety cables for use in mines where there is firedamp. It appears to be taken from the same article which was abstracted in the Digest, Apr. 14.

Fuses.—Some regulations regarding the construction of fuses, as used in Hanover, are given in the "Elek. Zeit.," Aug. 30.

ELECTRO-CHEMISTRY.

Hermite High Tension Electrolyzers.—A device is described and illustrated in the Lond. "Elec. Rev.," Aug. 31, for electrolyzing small quantities of seawater for flushing and disinfecting purposes in private plants; it consists of 7 or 14 cells connected in series in one apparatus and is designed so that the ordinary lighting current of 100 volts can be used; a current of 15 amperes is required; 0.8 grs. per ampere-hour are obtained in each cell; with the larger one, one hour's working will produce 80 gallons of the solution at 0.5 grs. of chloride per litre; the cost of these 80 gals. is given at 25 cts. at the rate of 16 cts. per kilowatt-hour; to this the trifling cost of the salts must be added when seawater is not available; for a private house the cost will be merely trifling; it is recommended for hospitals and public buildings and espcially for steamers fitted with electric light.

Purification of Sugar.—The Lond. "Elec.," Aug. 31, abstracts briefly from a recent article by Mr. Bersch, in which he shows that the results are very satisfactory. The sugar juice is heated t 55° C, and is subjected for 10 minutes to a current of from 50 to 60 amperes at 6 volts, the anodes consisting of 7 zinc plates of a total surface of 64.5 sq. ft.; a grey green gelatinous substance is deposited at the cathode. By this means a better quality of refined juice is obtained in less time and with greater facility than formerly. The first cost of the plant at Hoym, in Germany, was paid for in a week by the superior economy of the process. Some additional data is given in the Lond. "Elec. Eng."

Amalgamating Zincs.—Mr. Oppermann, in the "Electrochem. Zeit.," for August, recommends very highly the following receipt: A nearly saturated solution is made of neutral sulphate of mercury in water with the addition of as much sulphuric acid as is necessary for the complete solution of the salt; to use it mix as much of this solution as is required, with as much of a solution of oxalic acid as is necessary to make a thin grey creamy mass; to this a little salamoniac is added and the zincs are then painted repeatedly with the mixture, after which the zincs are rubbed briskly and if necessary the process is repeated; it can be used even with very old rough zincs. Zincs thus amalgamated, besides having a very fine appearance, resist the action of acids and salts much better than those amalgamated in the usual way; they may afterwards be washed repeatedly with water; if they are not used at once they should be rubbed dry.

Storage Batteries.—In an article by Mr. Joel in the Lond. "Elec. Eng.," Aug. 31, he gives a list of English patents granted for accumulators, from 1866 to 1885 and some references to publications from 1831 to 1879; he shows that many inventions have already been patented many times over. The list is preceded by a description of the chemistry of accumulators by Gladstone & Tribe. He states that the most effective strength of the acid for economy of conversion of plate is about 1 to 10, equivalent to a specific gravity of about 1.150. According to Monnier & Guiton's estimate it takes 565,600 coulombs to peroxidize one kilogram (2.205 lbs.) of minium; according to Orava & Garbe each coulomb stored will set free 1.0289 milligrams of acid.

Purification of Zinc.—The Choate process is briefly described in the Lond. "Elec. Rev., Aug. 31; after certain metallurgical treatments in the fire the zinc plates are immersed in a solution of sulphate of zinc containing a little soluble chloride; on passing a current the pure zinc is deposited while the impurities settle in the bottom of the vat, where they may be recovered if desired.

Purification of Water.—Mr. Oppermann's article is concluded in the "Elek Echo," Aug. 25.

Soda.—According to the Lond. "Elec. Eng.," Aug. 24, an Austrian company proposes to erect works at Golling near Salzburg, for the electrolytic preparation of soda, etc., by the Kellner process; at this place the raw material can be procured cheaply, it being in a salt mining district and there is an available water-power of 2,500 h. p.

Practical Electrolysis of Chlorides.—A short article summarising the practical accomplishments in this direction, is published in the "Elek. Anz.," Aug. 23. The serial of Mr. Andreoli is continued in "La Lum. Elec.," Aug. 11.

Electro-Deposition of Cadmium.—A short article on this subject is published in the Lond. "Elec. Rev.," Aug. 24.

MISCELLANEOUS.

Treatment in Case of Accidents.—An article by Dr. Hedley, from the "Lancet," is reprinted in the Lond. "Elec. Rev" and "Elec. Eng.," Aug. 31. He states that if the elevation of temperature produced by the current exceeds 45° (if this is centigrade it is equivalent to about 113° F) death ensues by the coagulation of the muscular fibres of the heart, in which case recovery is not possible; but in most accidents the contact is generally of too short duration for producing this fatal elevation of temperature; d'Arsonval showed that this increase of temperature is not due to the heat generated directly by the current, but to the violent contractions throughout the whole muscular system, and also to the condition of asphyxia. For resuscitation he recommends the Laborde method, which is as follows: "With the thumb and index finger, either bare or covered by a handkerchief, the tongue is seized by its anterior third, and powerful repeated rhythmical tractions and relaxations are carried out with a frequency of about 15 to 20 times a minute. In making these tractions it is important to feel that the dragging action affects the root of the tongue. If, in attempting to seize the tongue, it is found that the jaws are closed and the teeth are clenched, open them with the fingers, if possible, or use as a wedge a piece of wood or the handle of a pocket-knife, or anything of the kind that may be at hand." He recommends that further experiments ought to be made in order to find out how the industrial currents injure or kill.

Accidents from High Tension Currents.—A translation of Mr. Claude's article abstracted in the Digest, Aug. 4, is published in abstract in the Lond. "Elec. Rev.," Aug. 24. "La Lum. Elec.," Aug. 11, notes seven recent fatal accidents, all of which were caused by alternating currents.

Ageing Brandy Electrically.—The Lond. "Elec. Eng.," Aug. 24, states that the annual report of the Brandy Distillers' Company shows that great progress has been made in the ageing of brandy by electricity, enabling them to dispose of their brandy at advantageous prices within 18 months after distillation; "the process consists of the application of ozonized compressed air to this spirit while it is under the influence of an electric current."

In a communication to the Lond. "Elec. Eng.," Aug. 31, Mr. Andreoli states that 18 months is extremely slow and shows that the apparatus is very imperfect; with a medium-sized apparatus a cask of wine can be ozonized within 4 to 6 hours, which should be followed with a rest of 3 months; the expense of this ageing is trifling and as the process is rapid it represents great economy.

New Book.

PERSONAL RECOLLECTIONS OF WERNER VON SIEMENS. New York: Macmillan & Co. 416 pages and portrait. Price, $5.00.

The "Personal Recollections of Werner von Siemens" is not only a review of the life of the author, but also a review of early electrical days, and therefore has a double value to electricians.

The style of the book is a vigorous one, and the reader will find its pages of more than usual interest, whether as the record of a useful and somewhat eventful life or for its contributions to the history of electrical development.

The father of Werner von Siemens was fortunate, or judicious, in the selection of a tutor, who first awakened in his pupil "the unextinguishable feeling of delight in useful work," though not every one would have profited by it as did young Siemens. He very soon showed a leaning towards mathematics and a distaste for the classics, which was fortunate for the public which has so largely profited by this preference.

In 1833, at the age of seventeen, young Siemens entered the army, and the years from 1835 to 1838 were spent at the Berlin Artillery and Engineering School, where one of the teachers was the mathematician, Ohm.

There he further developed his preference for mathematics, to which were added physics and chemistry. He says that "the fondness for these three sciences has remained all through my life, and has been at the bottom of my after successes." In 1840 he commenced experiments with the view of precipitating metals by means of the galvanic current. At this time he was involved as a second in a duel and was imprisoned, and to this confinement we probably owe the early discovery of the process of electro-plating. His first successful experiment was dipping a German-silver teaspoon in a beaker filled with a solution of hypophosphite of gold, connected with the zinc pole of a Daniell cell, the copper pole being connected to a louis d'or, serving as anode. The result was a satisfactory golden spoon. This process he sold for $160.

After his imprisonment he discovered a differential governor and then started the first establishment in Germany for gilding and plating. In this, and in many future projects, he was ably assisted by his brother William, who visited England and sold a patent for £1,500, and was so pleased with the prospects in that country that he decided to settle there.

After interesting himself with hot air engines he turned his attention to measuring the velocity of projectiles, paving the way to the invention of the chronograph. He next took up telegraphy, which occupied his attention on and off during the rest of his career. In the course of this work he intrusted the construction of some devices to a young mechanician named Halske, who completely gained his confidence. In 1846-7, after successfully purifying gun cotton with sulphuric and nitric acid, he first used gutta-percha as an insulator, and meeting with considerable success in telegraphy, he decided to devote all his time to it, and in partnership with Halske started a small workshop for the manufacture of telegraphic apparatus. The rising of the people in Schleswig-Holstein against the Danes furnished him another opportunity to distinguish himself. He planted submarine mines, electrically connected to observation points on shore, and the knowledge of this fact kept the Danish fleet out of the harbor of Kiel. This invention, though undoubtedly his, was by many ascribed to Prof. Jacobi in St. Petersburg. After the war he took charge, during the winter of 1849, of the construction of a telegraph from Berlin to Frankfort-on-the-Main, the first long distance telegraph line at work in Europe. In June of 1849 he had requested his military discharge and soon afterwards also resigned his office as technical manager of the Prussian state telegraphs. The firm of Siemens & Halske was now firmly established and they shortly obtained a contract for the construction of a telegraph from Warsaw to the Prussian frontier. In 1853 Charles Siemens, who had charge of their Russian business, successfully completed the Kronstadt submarine cable. Shortly after this Werner assisted Newall & Co. to lay their first deep sea cable from Sardinia to Algeria, and although he was not engaged as the engineer of the undertaking, his plans and methods of laying were adopted and the final success is largely if not entirely due to him.

In 1857, after working intermittently for seven years, he elaborated his device for employing intermittent currents for quick correspondence on long cable lines. This consisted, briefly, of a polarized relay, so constructed that when the armature was moved by a short impulse to the contact it remained attached to this until a current in the opposite direction carried it back to the insulated stop. In the electrical supervision (undertaken by the firm of Newall & Co.) of the cable from Suez to Kurrachee, in India, 2,500 miles in length, he first used the end of the cable as earth connection, which was practically the first employment of the condenser in submarine telegraphy, without which the Atlantic cable would have been impossible. His firm undertook and carried out a great deal of cable laying for England and France, and finally met with losses which brought about a crisis in its affairs. Meyer and Halske, two of the partners, wished to give up the London house, but were opposed by the brothers, Werner and William, which resulted in the establishment of the London business as "Siemens Brothers."

During the years from 1850 to 1856 he was also busy with Halske in improving telegraphic apparatus and measuring instruments, of which only a few were patented, though many proved the basis of future contrivances. He also devised apparatus to ring bells over a whole railway line upon the departure of a train, and as magnetic-induction was found indispensable, he first used the now well-known Siemens armature. His "plate" machine, constructed in 1855 for getting continuous currents of high tension, was in reality the precursor of the modern dynamo and

transformer. He also wrote and showed the practicability of duplex telegraphy by means of electro-magnetic apparatus, and then, turning his attention to the electrical units, he first suggested and used a column of mercury as a standard resistance, which was afterwards adopted by the Vienna International Telegraph Congress.

In conceiving the bold plan of a telegraph line from England to India the necessary capital to carry out this project was raised in London and Berlin without the aid of bankers. This exemplifies the high standing of the firm.

As early as 1866 the question occupied his mind whether it would not be possible, by the suitable employment of the so-called extra current, to considerably intensify the induction current. This led him to the discovery and first application of the dynamo-electric principle. His claim for priority of this has been impugned and credit given in England to Prof. Wheatstone, but his first complete theoretical establishment of the principle in the printed Transactions of the Berlin Academy and its previous practical elucidation have been decisive in his favor.

His great influence and ability in other lines is well shown in his successful reform of the Patent laws. After hard work between 1860 and 1870 a patent tribunal was established which marked the first step. Through his endeavors, in 1876, the last great step was taken. A meeting of manufacturers and administration officials was called together from all over Germany, which made the draft of the Patent Protection Union the basis of their deliberations. The bill resulting was adopted by the Reichstag.

In 1868 the large undertakings and growing business of the firm had caused the voluntary retirement of Halske, who felt he could no longer oversee the large dealings of so great a firm in detail. The author devotes much space to a tribute to this valuable friend and co-worker. After his retirement and Meyer's death, which occurred shortly before, the three Siemens brothers assumed the entire management and remodeled the business, forming a joint establishment embracing all branches. In England they established their own gutta-percha factory, thereby enabling them to undertake cable laying on a large scale and breaking the great cable ring monopoly. William von Siemens designed a vessel, named the "Faraday," for the purpose.

The firm being entrusted with the work of laying the cable from Ireland to the United States, Charles von Siemens took charge of the "Faraday." By his wonderful pluck and perseverance they were enabled to pick up and repair the parted cable at a depth of 1,800 feet. The successful laying of this transatlantic cable raised the London firm to the highest pinnacle of success, and in 1881 Mr. Gould ordered by cable a double cable to America similar to the French cable recently laid by the firm—the so-called Ponyer-Quertier cable. The credit of the firm was so good that Gould declined to receive a representative to complete the contract, but remitted a large installment at once.

In 1882 the firm suffered a great loss in the death of William, who must have been a most extraordinary man, and to whose untiring energy and magnificent talents the success of the London house was almost entirely due.

At this time Werner was elected a member of the Berlin Academy of Science and his life after this was much taken up with scientific research and the publishing of scientific papers. Among other papers he published, in 1879, "Electricity in the Service of Life," and in 1886 "The Age of Science."

From this brief outline the remarkable character of this great pioneer in the electrical field may be surmised. The work is one of intense professional interest to the electrician, while the general reader will find it a most agreeably written account of a nature rich in the human qualities that command respect.

Electric Lighting on Coal Boats.

The lighting by electricity of the tow-boats, as they are used in the Pittsburg coal trade between that city and the port of New Orleans, is

AN ELECTRICALLY ILLUMINATED COAL BOAT.

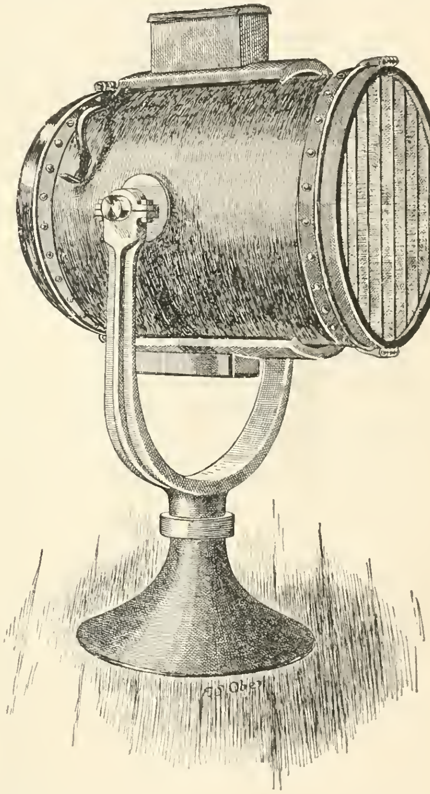
now becoming the method generally adopted for the illumination of these steamers, and its introduction has proved very satisfactory to the owners as well as to the crews of these boats.

The accompanying illustration is the picture of the steamer "Robert Jenkins," owned by the T. M. Jenkins Coal Company, and this boat is a very good representation of the general style of these steamers, of which there are operated about 100 between Pittsburg and New Orleans. They go up the Monongahela river for their cargo, which is loaded into barges at the different mines. The average capacity of the barges is 25,000 bushels of coal and one of the steamers will tow as many as sixteen and eighteen barges. The coal is taken down the Ohio and Mississippi, and is sold at the wharves of Cincinnati, Louisville, St. Louis and all points down as far as New Orleans.

The electric lighting plants on these steamers usually consists of a one-hundred light generator direct connected to a steam engine, so as to take up little space, and the generator furnishes current for the lighting of the boats as well as the search light. The plant on the Robert Jenkins was installed by the Westinghouse Electric and Manufacturing Company.

A New Searchlight.

The accompanying illustration shows the improved search lamp manufactured by Mr. S. W. Rushmore at his factory in Jersey City, N. J. The lamp shown is one of a complete line that he is building for all



A NEW SEARCH LIGHT.

classes of service, and is the type used mostly for river and inland navigation and as a buoy finder at sea. This type of lamp is made in sizes from five to forty amperes, with a glass lens mirror, or in cases where a perfectly straight beam of light is not a necessity, a plain parabolic reflector is furnished.

These lamps are made to operate on any direct current of high or low voltage. The feeding mechanism is of liberal proportions and the feed is not affected by the position of the light, which will work continuously in a vertical position, as when used for flashing signals on the sky when running in fog at night. This lamp is designed to meet the requirements of a marine light that will not easily get out of order, and of such construction that an ordinary mechanic can make repairs when necessary. A desirable feature in this lamp is that it takes full length carbons of twelve and seven inches, ensuring long running and economy of carbons. The lamp presents a very handsome appearance and is made of brass or iron as desired, with copper trimmings. Other types of this lamp run as high as 200 amperes and have attachments for operating from the pilot house or at a distance from the glare of the light.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, September 15, 1894.

THE ELECTRICAL STOCK MARKET developed a deal of life during the past week, various important electrical legal decisions contributing to affect the prices of one or two different stocks.

GENERAL ELECTRIC was subjected to various attacks, the price going down on one day alone 2½ per cent., the presumption being that the company would suffer by the Court of Appeals' decision in favor of the Westinghouse Company. Great publicity has been given to this decision, and this has created an adverse sentiment against the Company. Its officers, however, insist that the importance of the decision has been overestimated. They claim that losing the case does not hurt General Electric at all, though winning it would have been of the greatest value. They explain this as follows: Long ago the United States Electric Company and the old Edison Company became involved in legal difficulties about the patents in dispute; pending litigation, it was agreed that both companies should manufacture under the patents involved. Afterwards the Westinghouse Company absorbed the United States Company and the Edison was merged into the General Electric Company, the old arrangement continuing. Had the General Electric won, it could have collected large royalties from other companies, but as the device has now been declared non-patentable, it will meet no further competition in its manufacture than it has all along had to contend with.

WESTINGHOUSE ELECTRIC issues naturally have been strong for the very reasons that combined to weaken General Electric's quotation. In the appeal from the lower courts' decision against the company for supposed infringement on a patented "electric distribution and translation system," the Westinghouse Company has gained all its points, so that its field of operations, according to official assertions, is greatly enlarged. The railroad department has been unusually busy of late; many large orders have just been contracted for, and the new works at Brinton, Pa., near Pittsburg, when once opened, will have enough to keep them in operation for months.

NORTH AMERICAN PHONOGRAPH COMPANY stock is becoming less valuable every day. As a result of the receivership at Newark, the Sheriff has taken possession of the company's premises in Chicago for non-payment of rent. It is freely stated that all the hostile steps are really directed by Mr. Edison himself, as he is understood to have an improved machine ready for market

WESTERN UNION TELEGRAPH stock holds up exceedingly well, and, in view of the showing of earnings just made, this is not to be wondered at. The directors this week declared the usual 1¼ per cent. quarterly dividend, and presented the following statement for the September 30 quarter, all figures partly estimated: Net revenue, $1,800,000; interest and sinking fund, $243,500; balance, $1,157,500; dividend, $1,192,000; surplus, $365,000; accrued surplus, $7,372,633; less for American Rapid Telegraph, $550,000; surplus, $6,822,633. The official comment on the purchase of the Rapid Telegraph Company is as follows: "Purchase of the telegraph lines and the property of the American Rapid Telegraph Company with 5,500 shares of capital stock issued out of the increased stock authorized by the stockholders on October 12, 1892, $550,000." The purchase saves $52,550 a year rental, and other benefits accrue to the Western Union Telegraph Company from the deal. About $4,500,000 of the surplus represents the treasury stock. The fiscal year ends June 30, and the annual report will be out next month. It will show about as follows: Net revenue, $5,792,483, as compared with $7,496,037 in 1893 and $7,598,547 in 1892; interest and sinking fund, $978,711; balance, $4,813,772; surplus, after dividend, $173,710, as compared with $1,930,840 in 1893 and $2,158,385 in 1892.

THE EDISON ELECTRIC ILLUMINATING COMPANY of New York, through Treasurer Joseph Williams, furnishes The Electrical World with the following figures of earnings and expenses: August gross earnings, $91,955, increase, $17,396; net earnings, $38,985, increase, $14,110; interest on bonds, $17,966, increase, $7,336. For eight months ending August 31, the company reports: Gross earnings, $866,358, increase, $101,069; net earnings $454,357, increase, $113,682; accrued interest on bonds, $135,399, increase, $38,695. In August the company had installed 196,872 incandescent lights, a gain of 36,339; 2,620 arc lamps, a gain of 547, and motors aggregating 7,080 horse power, a gain of 1,900.

THE BROOKYLN EDISON ELECTRIC ILLUMINATING COMPANY makes a similar by good showing for August. Gross earnings were $29,351, a gain of $11,680; net earnings, $9,341, increase, $4,639; total net income, $10,241, increase, $4,411; less interest and fixed charges, $2,100; applicable for dividends, $8,141, a gain of $4,411, or 118 per cent. increase. The regular quarterly dividend of 1½ per cent., payable October 15, has been declared.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	3
General Electric	100	38¾	39
General Electric pref		70	72
Interior Conduit & Ins. Co.	100	35	45
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35¼	36
" " pref	50	52¾	53

BONDS.

*Edison Electric Ill., New York	1,000	107½	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202	204
American District Telegraph	100	42	49
American Telegraph & Cable	100	91½	92
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	145
Erie Telephone	—	49	49¼
Gold & Stock Telegraph	100	100	103
Mexican Telegraph	100	185	200
New England Telephone	—	68	69
Western Union Telegraph	100	90⅞	91

* Ex-div.

NEW INCORPORATIONS.

THE MUTUAL TELEPHONE COMPANY, Fort Scott, Kas., capital stock $1,000, has been incorporated.

THE ELECTRO-MAGNETIC TRACTION COMPANY, Washington, D. C., capital stock $5,000,000, has been incorporated.

THE CANTON LIGHT, HEAT AND POWER COMPANY, Canton, O., capital stock $50,000, has been formed to supply electricity.

THE CITIZENS' ELECTRIC COMPANY, Middletown, O., capital stock $20,000, has beeo formed to furnish light, heat and power.

THE OHIO STORAGE BATTERY COMPANY, Cleveland, O., has been incorporated, with a capital stock of $1,000, to manufacture electrical devices.

UNITED TELEGRAPH, TELEPHONE AND ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to operate telegraph and telephone lines.

THE NORWOOD CONSTRUCTION AND ELECTRIC COMPANY, Chicago Ill., capital stock $20,000, has been formed to build, construct and operate electric plants, railways, appliances, etc. E. D. Smith, N. Sampson and J. A. Low are interested.

THE CHARLES F. RICH COMPANY, Detroit, Mich., capital stock $20,000, has been formed to manufacture, buy and sell electric fixtures, etc. W. Boileau, Philadelphia Pa., Fred J. Linsell and C. F. Rich, of Detroit, Mich., are the organizers.

THE PHOENIX ELECTRIC LIGHT COMPANY, McKeesport, Pa., capital stock $5,000, has been formed to supply electricity for light, heat and power. J. E. Heinsman, W. S. McLain, Jr., Pittsburgh, and E. C. Johnson, Allegheny, Pa., are interested.

THE BLOCK LIGHTING AND POWER COMPANY, NO. 1, New York, capital stock $50,000, has been formed to manufacture electricity for producing light, heat and power. R. Stafford, A. M. Palmer and Edw. Lauterbach, New York, are the incorporators.

THE NORWOOD ELECTRIC LIGHT AND POWER COMPANY, Potsdam and Norfolk, N. Y., capital stock $5,000, has been formed to generate and sell electricity. G. W. Richards, W. D. Fuller, F. L. Smith and W. H. Wells, Norwood, N. Y., are interested.

THE MOMENCE ELECTRIC BALL STORAGE BATTERY COMPANY, Momence, Ill., capital stock $15,000, has been formed to manufacture storage batteries and other electric appliances. C. A. Smyth, L. Walker and F. E. Lane are the interested parties.

THE COALPORT-IRVONA LIGHT, HEAT AND POWER COMPANY, Coalport, Pa., capital stock $10,000, has been formed to supply light, heat and power to the public by electricity. R. A. Holden, A. P. MacLeod, Coalport; and J. E. McDowell, Irvona, Pa., are the promoters.

BROWN'S ELECTRICAL SUPPLY COMPANY, Minneapolis, Minn., capital stock $250,000, has been formed to manufacture electrical and mechanical appliances, attachments, machines, etc. C. D. Brown, W. H. Brown, and P. W. McAllister, all of Minneapolis, are interested.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., capital stock $5,000, has been formed to manufacture and sell electrical heating devices, cooking devices, dynamos, etc. The promoters are John Heffron, B. H. Scranton and F. H. Date, Detroit, Mich.

THE NORTHERN ELECTRIC PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $100,000, has been formed to construct, maintain and operate an electric railway. A. C. Milliken, Pottsville; C. H. Davis and N. A. Waldorn, Philadelphia, Pa., are all interested.

THE TAMPA AND PALMETTO BEACH RAILWAY COMPANY, Tampa, Fla., capital stock $30,000, has been formed to build and operate a street railway, and also electric plants. R. W. Easley, W. H. Kendrick, and Louis T. Kendrick, Tampa, Fla., are the promoters.

THE ELECTRICAL ADVERTISING AND SIGN COMPANY, Portland, Me., capital stock $100,000, has been formed to manufacture and deal in electrical goods and apparatus of all kinds. C. L. Lacobe, E. R. Reynolds and J. V. Davis, New York City, are the incorporators.

THE READING AND POTTSTOWN ELECTRIC RAILWAY COMPANY, Reading, Pa., capital stock $100,000 has been formed to construct, maintain and operate an electric railway. The interested parties are K. A. Fitchthorn, R. L. Jones and M. C. Aulenback, Reading, Pa.

THE SOUTHWESTERN SUBURBAN RAPID TRANSIT COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to build and operate an electric or other railway, and to build and maintain electric plants. A. H. Minasian, N. Wilcoxon and F. M. Sherman are interested.

THE MIDDLETON ELECTRIC LIGHT AND POWER COMPANY, Middletown, O., capital stock $4,000, has been formed to generate and supply electricity for light, heat and power. E. H. McKnight, J. Schuer, W. J. Peters, G. S. Long, S. J. Miller and J. Henne are the interested parties.

THE LANCASTER AND SUSQUEHANNA RAILWAY COMPANY, Lancaster, Pa., capital stock $100,000, has been formed to construct, maintain and operate an electric street railway. J. S. Graybill, Lancaster; W. B. Given, Columbia, and H. L. Haldeman, Chickies, Pa., are the organizers.

THE CHICAGO, OAK PARK AND HARLEM STREET RAILWAY COM-

PANY, Chicago, Ill., capital stock $50,000, has been formed to build and operate railways, also electric light plants. J. C. Schumacher, Jr., J. Gnaedinger, G. A. Pudewa, F. Troost and H. D. Schumacher are the interested parties.

THE CHATEAUGAY ELECTRIC LIGHT AND POWER COMPANY, Chateaugay, N. Y., capital stock $6,000, has been formed to manufacture and use electricity for producing light, heat and power. E. A. Douglass, Mrs. M. A. Douglass, Hattie E. Douglass and A. S. Douglass are the incorporators.

THE MONTICELLO LIGHT, HEAT AND POWER COMPANY, Monticello N. Y., capital stock $20,000, has been organized to generate electricity and to sell electric light, heat and power. F. B. Hulse, Thompsonville, Meda E. Stone, New Brighton, and H. R. Hulse, New York City, N. Y., are interested.

THE OROVILLE GAS, ELECTRIC LIGHT AND POWER COMPANY, Oroville, Cal., capital stock $32,000, has been formed to deal in and operate electrical and gas works, etc. M. Marks, F. H. Gray, C. H. Shiveley, J. C. Osgood, C. W. Putnam, W. J. Schneider and W. E. Dunvan, Jr., Oroville, Cal., are interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Sept. 16, 1894.

MR. W. D. HILLS, of the Electric Inspection Department, of Chicago, was in the city last week.

MR. ELIASREIS, of the Ries Electrical Specialty Company, of Baltimore, Md., was in the city last week.

MR. H. H. CUTLER, Treasurer of the Cutler Hammer Manufactuirng Company, Chicago, was in New York last week.

MR. DILWORTH RICHARDSON'S address, which has formerly been St. Paul. Minn., is now 10 Wall street, room 45, New York city, and any mail addressed there will reach him.

MR. AUERBACHER, of the Automatic Specialty Company, New York, is now equipping the Central Park apartment building, New York, with central station synchronizing time system.

MR. HENRY B. OAKMAN, of New York, general Eastern agent of the Western Electric Company, reports the sale of two 80-kw. generators for the New York Industrial building. This is in addition to three Edison machines which have been running for some time.

THE BALL ENGINE COMPANY, Erie, has just placed two tandem compound engines, one 125 and one 175-h. p., in the station of the Greenwich Gas & Electric Light Company, Greenwich, Conn. These engines were furnished by J. W. Parker & Co., New York, representatives of the Ball Engine Company.

MR. HUGO REISINGER, 38 Beaver street, who is personally interested in the manufacture of the "Electra" Nurenberg high grade arc lighting carbons, is meeting with very gratifying success. Central stations which have adopted these carbons for arc lighting have found immediate improvement, which is attested by many testimonials.

MR. THOMAS AHEARN, of the firm of Ahearn & Soper, and president of the Consolidated Electric Light and Street Railway Company, of Ottowa, Can., arrived with his family on the steamship "State of Nebraska" last week from Europe, where they have been spending the summer. They left for Ottawa, all in fine health and spirits, the same evening.

THE AUTOMATIC ELECTRICAL SPECIALTY COMPANY has moved its office from the second to the third floor of the Electrical Exchange, into more commodions quarters. The former quarters had become too small and inadequate for the proper conduct of the continual growth of this company's business. Mr. Auerbacher, the head of this concern, reports that he has recently been awarded the contract for the complete installation of an electrical plant in Saenger Hall, Newark, N. J. This plant will consist of 2,000 incandescent lights, stage lighting, watchman's time detector system, Ball Wood engine and Edison dynamo.

NEW ENGLAND NOTE.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, September 8, 1894.

THE BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS has removed its office from 13 Beacon street to Rooms 144, 145 and 146 in the new State House Extension. Of the various entrances to the building only the northerly (Derne street) and the easterly (Bowdoin street) are open to the public, and the latter is not yet finished. Both these entrances are in the basement of the building, and the offices of the board are on the next floor above, in the west corridor.

News of the Week.

TELEGRAPH AND TELEPHONE.

WHEELING, W. VA.—The Peoples' Telephone and Construction Company will construct a telephone line, and are now in the market for wires, poles, insulators, etc. W. D. Johnson is the secretary.

WINCHESTER, KY.—The Winchester Telephone Company has been organized with R. P. Scobee, president, and C. H. Rees secretary and treasurer, to establish a city telephone system.

ELECTRIC LIGHT AND POWER.

CHICAGO, ILL.—Bids for the electric plant for the new Court-house will be received to September 26.

LANCASTER, PA.—The Borough Council decided at its regular meeting to light the town with electricity.

CUMBERLAND, MD.—The Cumberland Electric Light & Power Company is increasing the capacity of its plant.

ATHENS, GA.—R. L. Bloomfield is erecting an electric power house to supply power for the manufacturing industries.

WELLS, MINN.—The $20,000 water and electric light 5 per cent. bonds have been sold to Mason, Lewis & Co., of Chicago.

LANCASTER, O.—Address C. D. Hilles, secretary Boyer's Industrial School, regarding an electric light plant to be installed.

FLORENCE, COL.—The city has voted to grant a franchise to a Denver company to erect an electric light plant in Florence.

PENSACOLA, FLA.—The Citizens' Electric Light & Power Company has selected a site for its new plant and will erect same at once.

GAFFNEY, S. C.—The Gaffney Manufacturing Company will put in a new dynamo of sufficient power to supply lights for the city.

ST. HELEN'S, ORE.—St. Helen's will have an electric light system, a franchise having been granted for that purpose for 10 years.

BROOKLYN, N. Y.—The Brooklyn Gas & Electric Light Company has asked for a franchise under which it could operate in the city.

GETTYSBURG, PA.—The power-house of the Electric Light & Railway Company has been destroyed by fire, with a loss of $40,000.

GAFFNEY, S. C.—The Gaffney Manufacturing Company will put in a new dynamo large enough to enable it to supply the city with lights.

KALAMAZOO, MICH.—The Commercial Electric Engineering Company has been awarded the contract for erecting the electric light plant.

PORTLAND, ORE.—Address W. H. Merrick regarding a contract to be awarded for arc and incandescent lamps for a term of two years, commencing April 1, 1895.

CANTON, OHIO.—J. W. Wilder, of Cleveland, has received the contract for wiring the new City National Bank building with 405 lights on the three-wire system.

STEPHENSVILLE, TEX.—The City Council is considering several propositions for the erection of an electric light plant and water-works. Address the Mayor.

BELVIDERE, ILL.—Several machines at the electric light plant were burned out and nearly every telephone in town was more or less damaged in a recent storm.

PELZER, S. C.—The Pelzer Manufacturing Company is in the market for an electric power plant with which to operate its new cotton mill containing 48 spindles.

HALLOWELL, ME.—Address Johnson Brothers concerning estimates on the cost of an electric light and power plant for a shoe factory employing 400 operatives.

MT. VERNON, ILL.—Address F. Suddoth concerning a contract to be awarded for furnishing the city with not less than 30 nor more than 40 arc lights of 2,000 c. p.

VANCOUVER, B. C.—Address T. F. McGuigan concerning a contract to be awarded for an arc light plant of 200 lights, 2,000 c.p., and an incandescent plant of 42,000 lights.

POINT PLEASANT, N. J.—The availability of this place as a winter as well as a summer resort will be materially increased by the proposed extension of the trolley line to Lakewood.

MAMARONECK, N. Y.—The Larchmont Electric Company has contracted for its power station with the Berlin Iron Bridge Company. The station will be 50 feet wide and 90 feet long.

WAKEFIELD, MASS.—The town has voted to appropriate $20,000 of the bonds recently issued for extending and enlarging the municepal light plant. Judge E. A. Upton is Moderator.

WYTHEVILLE, VA.—A. C. Coulter and others have been awarded the franchise for the establishment of an electric light and power station, the power to be developed from the Reed River.

THE WASHINGTON ELECTRIC LIGHT, HEAT AND POWER COMPANY, Washington Court House, Ohio, desires to receive prices on a 75-kw. alternator that it is proposed to add to the plant.

TORONTO, CAN.—Address W. T. Stewart, chairman of the Committee of Fire and Light, concerning the contract for lighting the city with electricity for a period of five years, from January 1, 1896.

ST. JOHN'S, MICH.—The question of public lighting is just now being discussed by the Common Council—whether or not the street lighting shall be done wholly by electricity, or electricity and gas, as now.

SOUTH MILWAUKEE, WIS.—The Electric Light Committee, of the South Milwaukee Village Board will report in favor of purchasing the Williams & Mansfield lighting system, rather than pay $100 each for arc lights.

ALLEGHENY, PA.—The Western Electric Company has been awarded the contract for the electric light plant for $70,769.70, providing that Director McAffee examines the bids and finds the figures the same as those of the committee, and if not, the contract will go to the lowest bidder.

WHITEHALL, ILL.—At a meeting of the City Council the contract with the Green County Electric Light Co. was declared void, it having expired by limitation. A bid to furnish lights at the rate of $60 per year for each 1200 candle power lamp was submitted by Mr. Gleason, of Chicago, and was referred to the Committee on Electric Lights.

PENSACOLA, FLA.—At a meeting of the directors of the Citizens' Electric Light & Power Company, it was decided to purchase the Hudson property between Palafox and Main streets, as a location for its plant. It was also decided to begin operations at once, and an order for the machinery will be given as soon as the details are decided, which will be at an early date.

The Electric Railway.

LUDINGTON, MICH.—The Council granted a franchise for an electric railway.

MERCED, CAL.—An electric road is to be built from this place to the Seth Cook gold mines.

MEDIA.—Experts have begun the work of locating the trolley line between Media and Newtown Square.

NEWARK, N. J.—The people are desirous of having a double track rapid transit road built to Franklin.

KNOXVILLE, TENN.—Clark Rude has been authorized to build an electric road in the city. Charles J. Pogue is his local representative.

TACOMA, WASH.—Frank C. Ross is again agitating the proposition to construct an electric railway from this city to Sumner and Puyallup.

GREENVILLE, TEX.—J. O. Adams and others have secured the right-of-way for an electrical railway which a company now organizing will build.

NEW BRUNSWICK, N. J.—Two railroad companies have asked privileges of the city at the meeting of the Board of Aldermen for a street railroad here.

OCEANPORT, N. J.—The prospect of having an electric railroad from Long Branch to Red Bank, connecting at this place, is now almost an assured fact.

OPELIKA, ALA.—Construction work has been begun on the electric road from Opelika to Auburn. John L. Cowan is one of the principal interested parties.

CORTLAND, N. Y.—The board granted the application of the Cortland & Homer Street Surface Railway Company for permission to use electric power in operating its road.

MANCHESTER, N. H.—The Committee on Electric Street Railways will meet to discuss the matter of an electric road, and will probably make some recommendations to the board.

SOMERVILLE, N. J.—After two months' contest the Council of Somerville has granted the right-of-way through the main street to the New York & Philadelphia Traction Company.

NEW ALBANY, IND.—An electric line bewteen New Albany and Wyandotte Cave is being agitated by the citizens of Corydon and Leavenworth. Judge G. B. Cardwell is interested in the project.

PORT CHESTER, N. Y.—A proposition is under way to build an electric road from Glenville by way of King street to Port Chester and from Byram bridge to the Mamaroneck bridge with a spur to Rye Beach.

BANGOR, ME.—The latest scheme on foot is an electric railroad running from Bangor through Veazie, Basin Mills, Orono, Great Works, Old Town, Still Water, thence to Newcom's Landing and Bangor.

VERONA, N. J.—The Verona Town Board unanimously passed an ordinance giving the North Jersey Street Railway Company a franchise to contruct and operate an electric road through Verona township.

WASHINGTON, D. C.—The Columbia Railway power-house, for which proposals will be asked for in a few days, will soon be erected. When the contract is let work on the plans for the car-house will be commenced.

NEW PALTZ, N. Y.—It now looks as if the New Paltz & Highland Electric Railroad would be built after all, a contract having been made with Philadelphia parties to build it. Mr. Van Steenburg is Superintendent and Track Master.

NEW BRITAIN, CONN.—Surveyors from New Britain, representing the electric railway company there, were in Newington and surveyed a new route which makes the distance between Hartford and New Britain 8 miles instead of 9, as by the other company's survey.

CHARLOTTESVILLE, VA.—The consolidation of the Charlottesville & University Street Railway Company, with the Charlottesville University Electric Light Company and the equipment of the street railway with electricity, is proposed. R. P. Valentine can give particulars.

BINGHAMTON, N. Y.—The Binghamton Street Railroad Company has received permission to double the track on the lower portion of Washington street, De Russey street, from the south end of the bridge to Vestal avenue, and a portion of Vestal avenue and Park avenue to Rose Park.

CRISFIELD, MD.—The Somerset Electric Light and Street Railway Company chartered by the last legislature, is perfecting its organization and will shortly be in the market for an electrical equipment. Thomas S. Hodson, 6 East Lexington street, Baltimore, may be addressed in regard to same.

WHITE PLAINS, N. Y.—Application has been made to the Highway Commissioners of the town of Greenburg by the White Plains, Elmsford & New York Railroad Company for the right to construct an electric railroad on the Tarrytown and White Plains road, from White Plains to Elmsford.

PITTSBURG, PA.—The company which received permission to construct an electric railway from Pittsburg to Kiskiminetas has received right-of-way to construct their line through Freeport, Tarentum, Natrona, Springdale, Hites, Aspinwall and Sharpsburg. S. H. Hicks, of Philadelphia, is interested.

NEWARK, N. J.—The Consolidated Traction Company will erect a one-story brick power station, 191x155, on River street. The plant will be equipped with 32 boilers, having a combined horse power of 6,000, six engines of 1,000-horse power each, a mammoth traveling crane and modern electrical machinery. The estimated cost is $400,000.

FORT WORTH, TEXAS.—The Polytechnic Street Railway has been sold to Messrs. R. Vickery, S. S. Ash and George Tandy. The company has applied for a new charter, and will be incorporated as the Glenwood & Polytechnic Street Car Company. As soon as possible the road will be extended to the Polytechnic College campus and also into the city.

PHILADELPHIA, PA.—Plans were approved by the Building Inspectors for the power station to be erected on the site of McBride Bros.' old coal wharves, Twenty-fifth and South streets, for the Electric Traction Company. The structure will be of stone and iron, 141x90 feet, and will be built on driven piles. There are to be four engines and four boilers in the building, which, with the machinery, will cost about $225,000. Charles McCaul has the contract, and he will begin work at once.

FRANKLIN, PA.—Before the end of the present month, it is announced, the Electric Traction Company expects to commence running trolley cars on its Fifth and Sixth street line. The contract for the extension to Franklinville has been awarded, and, as the plans have been approved by the Highway Supervisors, work is to commence immediately. The contract for the laying of the rails has been awarded to Contractor Shields, and Councilman R. C. Horr will do the paving. Senator Charles A. Porter has the contract for laying the track on Baltimore avenue, from Thirty-ninth street to the city line at Angora.

PHILADELPHIA, PA.—At the monthly meeting of the Park Commissioners on Saturday, Mr. Sellers offered a resolution, which was adopted, authorizing the Committee on Plans and Improvements to ascertain the cost, etc., of laying a double track passenger railway, to be operated by the trolley system, on the west side of Belmont avenue north from Elm avenue, to connect with the tracks of existing railway companies, the owners of which shall agree to pay a proportionate share of the cost of maintenance, and to fix the fare not beyond two cents.

Miscellaneous Notes.

PROF. A. L. M'RAE has resigned his chair in the Missouri School of Mines to accept the chair of Physics in the University of Texas.

DR. PAUL SCHOOP, Zurich, Switzerland, has undertaken the translation into German of Prof. H. S. Carhart's work on Primary Batteries, and will also add a chapter on secondary batteries.

STORAGE BATTERY LITIGATION.—The Accumulator Company has filed preliminary papers for a motion of injunction against the Edison Illuminating Company, of New York, to enjoin the use of the chloride accumulator installation. The case came up on the 11th inst. before Judge Lacombe, but was postponed owing to the absence of counsel until next motion day.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its eighty-ninth meeting at 12 West Thirty-first street on September 19 at which a paper on "A Study of the Residual Charges of Condensers and their Dependence Upon Temperature," by Dr. Bedell and C. Kinsley, will be read by title and discussed, and another by E. A. Sperry, on "The Electric Brake in Practice," will be read and accompanied by practical demonstrations.

A SUGGESTION FOR THE FASTIDIOUS.—A correspondent suggests that for the benefit of those users of the telephone who object to the word "hello," the word "tel-ho" be substituted, a combination of the terms "tel" and "ho," each being clearly defined by Webster, and meaning in this connection. "A call or reply to excite attention at a distance." We can here have a word with a meaning befitting its use, and which is quite similar in sound to that meaningless term "hello."

ELECTRICAL ENGINEERING LECTURES.—A course of twenty-five lectures on "Electrical Engineering," by Mr. Max Osterberg, E. E., graduate of Columbia College, will be given on Saturday evenings, beginning October 6, 1894, in the Young Men's Christian Association Building, corner Twenty-third street and Fourth avenue. Tickets, $6.00. For further information apply to Educational Secretary Waldo H. Sherman, 52 East Twenty-third street, or to Mr. Osterberg, 232 East Sixty-second street, on or before October 1, 1894.

MOORE, EDISON AND TESLA.—The Pittsburgh Despatch prints a syndicate article on a storage battery bicycle, entitled "A Revolution in Wheeling," illustrated with a portrait of Mr. D. McFarlan Moore, from which we extract the following: "And of all the men who have devoted their knowledge to this aspect of motive energy, D. McFarlan Moore has, probably, attracted most attention. This young man is, indeed, as remarkable from the human point of view as is his science from a physical aspect. Edison himself takes no small amount of pride in his rising pupil's achievements. There is hardly a detail of electrical science which he has not at his finger tips. His discoveries in the possibilities of molecular vibration as a source of electric illumination, have recently attracted attention in two continents. In the application of old principles to new uses he has made Edison's fame as a teacher equal to the renown of his name as an inventor. With Nikola Tesla he divides the allegiance of the electrical world as the rising sun of science. Although in the twenties, Mr. Moore's name is a part of the vocabulary of every student of electricity."

YOUNG MEN'S INSTITUTE OF THE Y. M. C. A.—There will be special exercises at the Young Men's Institute, 222 Bowery, New York, Tuesday, October 2, to formally open the Educational Department of the work. There will be music and short addresses in the large hall, and all the class rooms will be open for the inspection of the visitors. An excellent educational work is being done by the institute each year. Instruction is given in the following subjects: Steam Engineering, Practical Electricity, Sanitary Plumbing, Carriage Drafting, Mechanical Drawing, Architectural Drawing, Free-hand Drawing, Arithmetic, Book-keeping, Penmanship, Shorthand, Typewriting, English Grammar and Composition, Vocal Music and Glee Club, and First Aid to the Injured. The classes are open to all young men between the ages of 17 and 35 years. A distinctive feature of this educational work is that the theory is taught to those who are getting the practical part of the subject in their daily work. Firemen are taught all the theory necessary for becoming engineers. Engineers are prepared to take charge of higher grade engines. Machinists are taught the mechanical drawing which they need in their work. Young men in offices are taught commercial subjects. In this way the efficiency and commercial value of each student is increased for his present employer. The enrollment for the season of 1893-94 was 425 young men. The quality of work done has shown a decided improvement each year. The school year continues until May, when diplomas and prizes are awarded by the Committee of Management. Admission is free to the opening exercises on October 2.

Trade and Industrial Notes.

THE IONA MANUFACTURING COMPANY, 536 Congress street, Boston, has issued a price list, No. 3, dated September, 1894, of its well-known line of electric lighting specialties, watchmen's electric time registers, electro-mechanical gongs, etc.

THE NATIONAL CONDUIT MANUFACTURING COMPANY, Times Building, New York, has received an important contract from the West, Chicago Street Railway Company. The contract is a very large one and the company naturally feels elated at having secured it in direct competition with all other styles of conduits.

THE COOPER-ROBERTS COMPANY, Mt. Vernon, Ohio, sends us a copy of its neat 1894 catalogue, which illustrates and briefly describes the improved, high speed, self-contained centre crank, automatic Cooper engine. The pamphlet is tastefully gotten up and well printed, and the wood engravings very plainly show all of the details.

H. B. COHO & COMPANY, 203 Broadway, New York, report the sale during the past week of three machines aggregating 110-h. p., to the Henry R. Worthington Company, for use in their Brooklyn works. Also three generators and five motors, aggregating 300-h. p., to Messrs. Nardi, Strang & Company, Philadelphia, for use in the new Odd Fellows' Hall, that city.

THE BALL ENGINE COMPANY, Erie, Pa., has the contract for furnishing the engine for electric lighting in the new Industrial Home for the Blind in the city of Chicago. This engine is to be direct connected to an Edison dynamo. Though Mr. Pashall, Detroit representative of the company, it is installing a 70-h. p. engine in the building of the Edison-Moore Company, Detroit.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is building a large addition to the machine shops of Henry R. Worthington, at Brooklyn, N. Y. The Berlin company has also received the contract for an annealing room building for the Naugatuck Malleable Iron Company, at Naugatuck, Conn. The building is 94 feet wide and 175 feet long, with brick walls and iron roof trusses covered with corrugated iron.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is warning the public against an imitation of the Packard lamp, which is now being offered to the trade with the statement that it is the Packard or just the same as the Packard but without the label. The company states that no lamps are genuine unless they bear the Packard trademark and are purchased from authorized agents of the Packard Company or the Electric Appliance Company.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., reports as a sign of the revival in the electrical business, the closing in three consecutive days last week of contracts for more than 1,500-horse power of its standard apparatus, consisting of direct connected and belted generators and their Manchester type slow speed motors. This, with the other work the Mather Company now has on hand, will compel it to at once increase its working force, although part of its works is now being operated at night.

THE CHESLEY ELECTRIC COMPANY, Hoboken, N. J., reports business brisk, and state that they have recently finished some large contracts for street railway specialties. They are repairing several large armatures and have excellent facilities for handling heavy work, as this department is located on the ground floor. An unusual feature of this company's business is the fact that its factory is never closed. This is done to accommodate its customers who may have a break-down requiring immediate attention. It is at present making some alterations on its building which will give more room.

THE DALE MANUFACTURING COMPANY, 22 Cortlandt street, New York, in a handsome 48-page catalogue, illustrates a large line of material such as may be daily required by operators of electric lighting and power plants, electrical contractors and wiremen. A number of pages are devoted to electrical fixtures and shades of standard and special patterns, and a very full line of various fittings follows. The catalogue will be found useful by the electric light man, as the matter has been selected with a view to the requirements of every day work, and therefore the pamphlet has not been padded out with all manner of cuts and prices that would detract from its value rendering reference less easy.

THE HARRISBURG FOUNDRY AND MACHINE COMPANY, Harrisburg Pa., sends us three luxurious specimens of catalogue making. One is a 11x16 20-page catalogue of the Harrisburg double engine steam road roller, beautifully printed on an extra fine quality of paper and illustrated with a large number of Bartlett engravings. Another consists of eight 9¼x11¾ cards enclosed in a stiff envelope. Each card contains an engraving of a type of the Ide engine, surrounded by a colored border, in one corner of which is a suggestive sketch; each card has also embossed in a corner the handsome trade-mark of the company. The third is a small 16-page catalogue of the Ide engine, in which each cut is surrounded by a handsome border, there being several designs of these. With such patrons as the Harrisburg Foundry and Machine Company, and the firm of Bartlett Company as artists, engravers and printers, catalogue making is approaching a fine art.

WARREN WEBSTER & COMPANY, Camden, N. Y., specialists in examining steam plants where economy in fuel is desired, and utilizing the waste exhaust steam, report considerable activity in their business, owing to the better appreciation of their manufactures in comparison with other standard apparatus for similar purposes. Among the recent contracts for the Webster "vacuum" feed water heater and purifier in connection with electric plants, they mention: B. & O. tunnel plant, Baltimore, Md., 3,000-h. p.; Westinghouse Electric and Manufacturing Company, Brinton, Pa., 2,500-h. p.; Berwick Electric Light Company, Berwick, Pa., 250-h. p.; Cincinnati Street Railway Company, Cincinnati, O., 1,000-h. p.; Arapahoe Street Railway Company, Denver, Col., 150 h.-p; Chicago Edison Company, North Side Station, Chicago, Ill., 2,000-h.-p., and 3,000-h. p. to the Johnson Company, Lorain, O. In a number of the above contracts the equipment of standard makes of feed water heaters was removed. Numerous orders were also received for the Webster separators and the Williams vacuum system of steam heating.

E. W. BLISS & CO., 17 Adams street, Brooklyn, reports that its European business has been very large recently. It shipped to Switzerland within the last two months a special watchmaker's drop hammer and several punching presses fitted with sub-presses for watch work; also a No. 1½ toggle drawing press. A large shipment was sent to Germany to one of the largest clock-making concerns in the world, of tools and machinery for the manufacture of clocks and their cases. France has also received a large shipment of tools for the making of granite enamel ware and kitchen utensils, and for several watch factories. Austria has not been behind the others, as she has also received a No. 1½ and 3½ toggle drawing press, No. 18, 19, 20 and 21 adjustable power presses, and No. 36½ and 39 power presses with a number of dies, and a No. 161 double action press with dies and special feed, for making primers. A large improved automatic perforating press is now nearly completed and will be shipped to England for the manufacture of perforated metals up to 50" in width. This speaks well for American tools in competiiton with those of foreign make.

THE BALL ENGINE COMPANY, Erie, Pa., sends us another list of its recent shipments of engines, although it is only a few weeks ago since we reported a long list. The list of shipments is as follows: Peninsula Light & Power Company, Houghton, Mich., one 350-h. p. tandem compound engine; Union Colliery Company, Victoria, B. C., one 160-h. p. engine; Edison, Moore & Co., Detroit, Mich., one 80-h. p. engine; Noyes, Norman & Co., St. Joseph, Mo., one 80-h. p. engine; City of Adrian, Adrian, Minn., one 70-h. p. engine, direct connected to a Siemens-Halske dynamo; J. W. Parker & Co., New York city, one 50-h.p. engine; Celedon Terra Cotta Company, Alfred Centre, N. Y., one 100-h. p. engine; Norton Bros., Chicago, Ill., one 150-h. p. cross compound engine; Berwick Electric Light Company, Berwick, Pa. one 160-h. p. engine; Sol Heyman & Co., New York City, one 60-h. p. engine; North Sub-district School, Fourth Ward Pittsburgh, Pa., one 35-h. p. engine; Geo. W. Childs' Public School Building, Philadelphia, Pa., one 60-h. p. engine; E. P. Dodge Manufacturing Company, Newburyport, Mass., one 50-h. p. engine; J. W. Parker & Co., New York City, for export, one 30-h. p. engine.

Business Notices.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 11, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York).

525,689. ELECTRIC TRANSFORMER; C. S. Bradley Avon, N. Y. Application filed August 22, 1891. This comprises a series of superposed laminæ of iron provided with two openings for the coils with an intervening web of iron, the wires constituting the coils being threaded through the openings and united at the ends so as to form a continuous circuit.

525,690. ELECTRIC RAILWAY SYSTEM; C. S. Bradley, Avon, N. Y. Application filed January 2, 1894. This comprises plurality of alternate current generators organized to impose on line currents of different frequency, distributing lines supplied thereby, and alternate current motors connected with the distributing lines.

525,697. WINDING FOR DRUM ARMATURES IN DYNAMO MACHINES; R. Eickemeyer, Yonkers, N. Y. Application filed March 9, 1892. This comprises independent coils, each having a long and a short side lying along the periphery of the drum and inclined ends lying across the end of the drum.

525,698. ARMATURE FOR DYNAMO ELECTRIC MACHINES; R. Eickemeyer, Yonkers, N. Y. Application filed April 13, 1894. A bipolar armature winding composed of rectangular coils assembled in groups, and having the ends of the coils in each group equally divided and located at opposite sides of the armature.

255,704. ELECTRIC CLOCK; F. L. Gregory, Chicago, Ill. Application filed January 30, 1894. This comprises a reciprocity member, a circuit-closer actuator, a circuit-closer carrier, a circuit-closer thereon adapted for limited movement independently thereof, and an electrical terminal in the path of the closer.

525,708. BUS BAR INSULATING SUPPORT; A. B. Herrick, Schenectady, N. Y. Application filed April 11, 1894 This comprises an L-shaped section for an insulating block formed with a transverse passageway for a conductor on the inner face of the long and short arm of the L-shaped piece, and with means on the outer face for securing the section in a frame.

525,735. ELECTRIC ARC LAMP; S. L. Campbell, Kalamazoo, Mich. Application filed January 23, 1894. This comprises a rocker frame composed of two pieces, combination coils, and suitable means of retaining the pieces together.

525,730. ELECTRIC FAN; C. Wachtel, Newark, N.J. Application filed January 17, 1893. This comprises a frame and fan shaft, an armature carrier on the shaft, consisting of a plate.sleeve and set crews thereon, lugs on the lower side of the plate and an armature secured to the lugs.

525,579. SYSTEM OF ELECTRICAL DISTRIBUTION; J. F. McElroy, Lansing, Mich. Application filed October 5, 1887. This comprises an electrostatic converter having its members separated by a dialectric, the thickness of which causes the fall in potential.

525,779. SYNCHRONIZING MECHANISM FOR ELECTRIC CLOCKS; E. Ayres, Sydney, New South Wales. Application filed October 7, 1893. This comprises a pair of pivoted arms, one of which constitutes the armature of a magnet, each provided with means for closing an electric circuit, the armature lever having a lateral extension underlying the other arm, whereby, when the armature is attracted by the magnet, it will be caused to lift the other arm and break the circuits.

525,789. TROLLEY POLE CONNECTION; M. R. and J. M. Crane, Newark, N J. Application filed November 10, 1893. This comprises a frame adapted to connect with the socket and having a hollow bridge or way, and an arm

connecting with the pole and pivotally secured to the holder and working in the bridge or way.

525,782. COMBINED BRAKE AND ELECTRIC SWITCH FOR STREET RAILWAY CARS; G. Brown, Long Island City. This comprises the car brakes, and a plurality of switches adapted to gradually increase or decrease the current, and means for applying or releasing the brakes, and actuating the switches successively at the same movement.

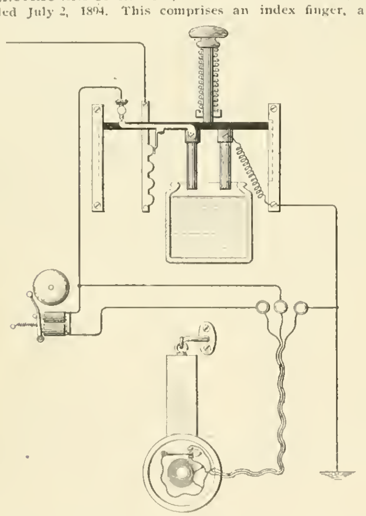
525,836. SELF-ADJUSTING BRUSH FOR DYNAMO ELECTRIC MACHINES; W. L. Bliss, Brooklyn, N. Y. Application filed April 13, 1894. This comprises a pivotal support upon which the brush carrier is fitted to rotate freely in either direction, and a fixed stop against which the brush carrier, rotated by the friction of the commutator on the brushes, is positively arrested in either direction to stop the brushes in positions the reverse of that which they occupy when the carrier is arrested in the opposite direction.

525,840. LIGHTNING ARRESTER; A. L. Courtright, Keokuk, Ia. Application filed February 1, 1894. This comprises two similar adjustable sections, each section composed of a non-conducting base, copper plates secured on each side thereof, a binding post projected through the copper plates, and insulating material with means for securing it therewith and electrodes in contact with both of the copper plates.

525,864. ELECTRIC RAILWAY; H. E. Rider, New York, N. Y. Application filed February 26, 1894. This comprises an arm having upwardly projecting branches and current collectors carried thereby and insulated therefrom and arranged to move in contact with the conductors.

525,866. ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS; P. Schwenke, Zerbst, Germany. Application filed April 8, 1892. This comprises a line circuit, a circuit breaker and relay, a signaling circuit, an electromagnet arranged in the signaling circuit, an armature pivotally arranged adjacent to the electro-magnet, a gear wheel mounted on the pivot of the armature, and a pivoted semaphore provided with a rack in engagement with the gear wheel.

525,874. ELECTRIC ANNUNCIATOR; H. C. Thomson, Boston, Mass. Application filed July 2, 1894. This comprises an index finger, a couple of



No. 525,703.—Telephone Call System.

helices so arranged as to admit of one armature core sliding between the two, a sliding armature core so arranged, and a rod running at right angles through the armature core.

525,886. TROLLEY FOR ELECTRIC RAILROADS; E. Dawson, Terre Haute, Ind. Application filed December 26, 1893. This comprises a socket, two brackets secured thereto and provided with screw-threaded bosses at their upper ends, and a hollow pin screwed upon the bosses and forming the bearing for the trolley wheel.

525,891. FASTENER FOR ELECTRIC WIRES; H. C. Fricke, Pittsburg, Pa. Application filed June 14, 1894. This comprises an insulating piece bent in the form of a cylinder when closed and having radially projecting edges.

525,888. MANUFACTURE OF CARBONS FOR ELECTRIC LAMPS, T. A. Edison, Menlo Park, N. J. Application filed March 20, 1880. A conductor for an electric lamp formed of a carbonized natural fiber of endogenous growth and made up of parallel elementary fibers.

525,894. RECORDING VOLTMETER; F. D'A. Goold, Schenectady N. Y. Application filed April 16, 1892. This comprises a coil and armature three levers, a connection between the centre of the first lever and the armature, a marking point connected to the central point, and a regularly movable surface on which the point is adapted to bear.

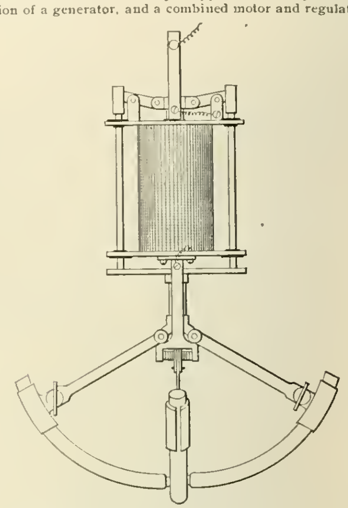
525,909. INCANDESCENT LAMP STAND AND REFLECTOR; G. F. Klemm, Philadelphia, Pa. Application filed June 9, 1894. This comprises a base, a supporting arm connected thereto so as to secure a reciprocatory motion, a slotted tube, a hanger attached to the middle thereof, and a knuckle joint connection between the supporting arm and hanger.

525,943. ELECTRIC ARC LAMP; H. E. Bradley, New Bedford, Mass. Application filed February 28, 1894. This comprises a lamp frame, feed rod, tilting lever, and main and shunt magnets arranged to tilt the lever and operate the feed rod, a cut-out comprising a spring plate secured to the lamp frame, a rod connecting the lever to the spring plate, and a relatively stationary plate arranged in the path of travel of the spring plate.

525,945. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; W. G. Creighton, Chicago, Ill. Application filed February 28, 1894. This comprises a track rail, a plate forming a conduit therewith and having a grooved portion overhanging the rail, and a slot closer in the groove and adapted to rest upon the rail edge.

525,992. SYSTEM OF LIGHTING AND HEATING CARS BY ELECTRICITY; M. Moskowitz, Newark, N. J. Application filed March 31, 1894. This comprises a working circuit, a dynamo, a pair of storage batteries and a switch for connecting either of the batteries with the dynamo.

525,993. MEANS FOR EQUALIZING ELECTROMOTIVE FORCE OF DYNAMOS; M. Moskowitz, Newark, N. J. Application filed June 15, 1894. The combination of a generator, and a combined motor and regulating dynamo,



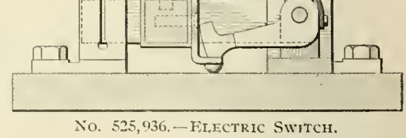
No. 525,743.—Electric Arc Lamp.

the armature circuit of the regulating dynamo being in circuit with the magnetic fields of the generator.

526,016. ELECTRIC MOTOR; J. S. Losch, Summit Station, Pa. Application filed March 6, 1894. The combination with a commutator, of a brush provided with ribbed or flanged ends, whereby a greater wearing surface is provided and the brush is more readily retained in position.

525,702. TELEPHONE CALL SYSTEM; E. T. Gilliland, Pelham Manor, N. Y. Application filed November 27, 1893. This comprises a telephone with a fixed attachment to connect the same with a support, and a resonator so related to the support that when the telephone is on the support the diaphragm will be close to the resonator.

525,703. TELEPHONE CALL SYSTEM; E. T. Gilliland, Pelham Manor, N. Y. Application filed January 11, 1894. This comprises a normally closed



No. 525,936.—Electric Switch.

circuit including a call receiving instrument, a dip battery for transmitting calling current, and connections for opening the circuit and cutting in the battery during immersion of its electrodes.

525,743. ELECTRIC ARC LAMP; A. B. Roney, Chicago, Ill. Application filed March 7, 1894. This comprises two pairs of carbons, each pair feeding to a common centre, one of the pairs being mounted in a movable framework and electro-magnetic means for forming and maintaining the electric arc between the two pairs of carbons.

525,936. ELECTRIC SWITCH; G. Baehr, Jersey City, N. J. Application filed January 9, 1894. The combination of a pair of circuit controlling blades, a cross-bar of insulating material mechanically connecting them together, a pair of jaws carried by the cross-bar, a manually operated swinging lever provided with an extension which is loosely embraced by the jaws and a spring bearing at one end against the lever and at the other end against the cross-bar.

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CONTENTS.

RESIDUAL CHARGES OF CONDENSERS.

As will be seen from the abstract published elsewhere, the Institute paper of Dr. Bedell and Mr. Kinsley deals with the soaking-in effect of dielectrics. Its conclusions bring out strongly the fact that the action of a condenser cannot be predicted in the absence of knowledge in regard to its previous history with reference to charges. The importance of this point in connection with delicate investigations is rendered apparent by the statement that in one case a condenser experimented on retained the effect of its past charges after being short circuited for a month. The numerous curves in this paper add very largely to the data bearing on condensers, and the *Transactions* receive an additional permanent value from being made the repository of such matter, which in the present instance may soon assume a practical importance from the more general adoption of condensers in alternating work. In the absence of an equivalent for a Royal or Philosophical Society or of an Institut de France in this country, the various professional societies perform a good office by thus fulfilling one of the functions of the old European bodies. It is not probable, either, owing to the modern specialization of science, that such an equivalent of an inclusive character will grow up here, so that it may be considered as one of the legitimate functions of the American Institute of Electrical Engineers to become the medium for the publication of the data of electrical investigations, even though of a purely scientific interest. Aside from the prestige that will thus be given, it cannot be known how soon a purely scientific matter may become one of practical importance.

ELECTRICITY IN BERLIN.

We print elsewhere some extracts from a book prepared for the benefit of the engineers present at the recent annual meeting of the German national engineering society at Berlin, which gives some interesting statistics in regard to the extent of the electric lighting, and of the telephone and telegraph systems of that city. It will be seen that Berlin is but little behind New York in electric lighting and in the use of the telephone, the number of incandescent lamps being 203,050, and of telephone subscribers, 23,420. The annual average coal consumption in the Berlin central stations is, as noted, surprisingly low, being only three pounds per horse power-hour of electrical energy delivered to the consumer. This is undoubtedly the result ot the careful study from an engineering standpoint to which every detail of central station design is submitted in Europe, and which is in striking contrast to the methods formerly the rule in the United States and not yet entirely obsolete. As we have before remarked in these columns, one reason for the general inferiority of our central stations to those of Europe has been the policy of not employing an engineer when laying down a plant, but depending almost entirely for the design upon the manufacturing company supplying the machinery. Such a system, owing to competition, results in only questions of first cost being given weight, for, when the sale of a plant depends only upon this factor, it would be folly, from a business standpoint, for the seller to increase the amount of his bid by the introduction of details involving superior efficiency that could not be appreciated by the ordinary purchaser. It is singular to note that the Morse recorder is still used in Berlin telegraph offices, the trial of the American sounder having just been instituted, and also that the lines are not quadruplexed.

THE CANADIAN ELECTRIC ASSOCIATION.

The present year has been noted for the lively interest which has been taken in the meetings of the various electrical professional bodies. The 1894 annual meetings of the American Institute of

Electrical Engineers, the National Electric Light Association and the Northwestern Electrical Association were the most successful in the history of those bodies, and the same seems to be true of the meeting at Montreal last week of the Canadian Electrical Association. The papers of Professors Rosebrugh, Mr. John Galt and Mr. E. A. Sperry are important contributions to professional literature, and the others on the programme were worthy of the occasion, if we except one or two of the perfunctory class, happily becoming more and more rare at such meetings. Mr. Keeley's method of distribution, as will be seen from the abstract we publish, is a close approach to the three-wire system; if, in fact, the plus or minus poles of the source of E. M. F. in this arangement were connected, we would have the three-wire system with a theoretical saving in copper of 62.5 per cent. instead of the 50 per cent. claimed by Mr. Keeley for his system. The design of fly-wheels is treated exhaustively in Mr. Galt's paper, and his thorough exposition of Prof. Sharp's new system of fly-wheel construction will be appreciated by those interested. With such authorities as Dr. John Hopkinson and Prof. Unwin advocating the use of the fly-wheel accumulators in central and power stations, the subject takes on an importance that cannot be neglected. Mr. Shaw's paper rendered a particularly good service by bringing up the subject of electrical medical nostrums, thus serving to counteract the influence of the favor which they met with in the electrical department of the World's Fair, and, more recently, in the columns of one of our contemporaries in the case of an electric hair brush. The paper by Prof. Rosebrugh is perhaps the most important on the programme, dealing, as it does, with an aspect of telephony to which, apparently, little attention has thus far been given. The social features of the meeting were not lesss successful than the professional ones, and our Canadian electrical friends are to be congratulated upon the success with which they are rivaling the older professional bodies of like character across the border.

INDUCTANCE AND CAPACITY.

The neutralization of the inductance of a line by means of a capacity, or vice versa, has been the subject of much mathematical writing, and of graphical demonstrations no more satisfying to those not accustomed to what might not inappropriately be called artificial methods of thought. What the average student of electrical phenomena wishes is first an idea of the mechanism of a phenomenon, as without this preliminary knowledge mathematical and graphical references to it will be likely to convey little information. For these the following may convey in a simple manner the idea of the respective action of a condenser and an inductance coil in series in an alternating circuit. Imagine the E. M. F. of the circuit to be rising; the result on the one hand will be that the condenser will be unbalanced and consequently will create a draught, so to speak, for enough current to again balance it; on the other hand, the increasing flow of current due to the increasing E. M. F. will introduce into the inductance coil lines of force opposing the flow of the current, or, in other words, lines of force generating a current in the opposite direction to the main current, and in the direction of the draught of the condenser. If now, the condenser and inductance coil are so proportioned to each other that these two effects are equal, the result will be that the flow of current in the circuit will follow the simple form of Ohm's law, the factors in the impedance formula for inductance and capacity cancelling each other. The relative effects of inductance and capacity may also be illustrated roughly by an analogue from steam engineering. In the exhaust pipe of a marine engine there is often a throttle valve, automatically actuated and used to prevent the engine from racing in a rough sea. In this case the throttle corresponds to an inductance and the steam condenser to a capacity. By opening the throttle wider (decreasing the inductance) or increasing the vacuum in the condenser (increasing the capacity) the flow of steam is facilitated; or, by increasing the vacuum and throttling at the same time, one effect will nullify the other, the increaased draught of the condenser being balanced by the increased throttling. In ocean cables the capacity interfering with the transmission of current, and in overhead transmission lines, the inductance increasing the drop, are distributed along the cable or line, and, therefore, to be theoretically neutralized the inductance in one case, or the capacity in the other, should also be distributed, so that the first illustration applies, not to the cable or line, considered as a whole, but to each infinitesimal portion of it.

ELECTRIC BRAKES.

The Institute paper of Mr. Sperry on electrical brakes has excited much interest, and deals with a subject which seems to be rapidly coming to the front. The electric brake possesses, undoubtedly, a balance of advantages, not only from the rapidity with which it may be placed in operation, but also from the greater power it can be made to develop. In the brake described the braking action involves three factors: First, the retarding torque of the car motor acting as a dynamo; second, the friction of the brake ring under the pressure due to magnetic attraction between the ring and the wheel; third, the torque due to the combination of the brake ring and wheel acting as a dynamo in the generation of eddy currents. The first effect is very small, and therefore does not cause the wear of gears which has rendered impracticable the use of street railway motors for braking by short-circuiting the armature; the second is more considerable, but the third effect is, singularly as it may seem, very large—in fact, the most important factor by far, if we accept Mr. Sperry's data, which we see, however, no reason to doubt. The arrangement, then, in principle, is an auxiliary braking dynamo of exceedingly simple construction, which has not the disadvantages incident to the use of the car motor for the same purpose. The manner in which the eddy currents are generated, and the determination of their paths, form the subject of an interesting problem, upon which the recent discussion in our columns on so-called unipolar dynamos may throw some light. Two explanations in regard to the former point suggest themselves. First, that the eddy currents are generated about the gap alone, because it is there only that the flux of magnetic force is varied; or, second, if we can assume a variation in pressure between the braking surfaces, the eddy currents generated in the gap are augmented by those resulting from this effect. Owing to the extremely small reluctance of the iron magnetic circuit, the introduction of an infinitesimal air gap would notably decrease the magnetic flux and thereby cause eddy currents, and it has been suggested that such an increase of reluctance may be caused by variation in pressure due to "chattering" or other variable action of the brake ring. Much of the data which Mr. Sperry gives in his paper on the subject has a value aside from the particular use there made of it, which is also true of his discussion of various points in regard to street railway braking. The controller described combines in itself the usual trolley controller and brake wheel, thus much simplifying the duties of the motorman. The ingenious and mechanically neat manner in which the various parts have been worked out excited much favorable comment at the Institute meeting, while the entire paper was received as one of timely importance and a worthy contribution to the *Transactions*.

Protection Against Lightning.

Thr London "Electrical Engineer" publishes a letter from Lord Kelvin with reference to the recent report of a lightning discharge at the Norfolk navy yard, by which two men were killed. He states it is proved by that accident that to secure against danger men working under a ship in dry dock there ought to be a thorough metallic connection, by wire rope or otherwise, between several points of the ship's iron, such as ringbolts, etc., and iron pipes leading to the water outside the dry dock. Similar precautions ought to be taken in respect to the frames of ships on the stocks in the course of building. An iron ship simply resting on wooden blocks, and without any connection by metal with the water of docks, or river, or sea in the neighborhood, is certainly dangerous, Lord Kelvin states, to persons standing on the ground and touching any part of the iron hull during a thunderstorm.

The annual meeting of the Canadian Electrical Association, which opened at Montreal on Wednesday, Sept. 19th, was one of the most successful gatherings of that body yet held, both in point of attendance and in the importance and interest of the papers presented.

President J. J. Wright, of Toronto, opened the proceedings by a few happy remarks of welcome and congratulation. Mr. C. H. Mortimer, secretary and treasurer of the association, presented his report for the year ending May 31, which showed that the number of active members was 99, and of associate members 38. The receipts during the year had exceeded the disbursements by $273. The report was adopted. Mr. J. J. York, on behalf of the Montreal branch of the Canadian Association of Stationary Engineers, tendered the visitors a hearty welcome, which was fittingly replied to by President Wright.

Mr. T. D. Lockwood, of Boston, who was present at the meeting, then had the distinction of being elected the first honorary member of the Association.

On reassembling after an adjournment for lunch the committees on legislation, statistics, by-laws and constitution were appointed, after which the first paper on the programme was read, which was that of Mr. W. B. Shaw's paper, and which dealt with "The Application of Electricity for Medical and Kindred Purposes from Light and Power Circuits." He first mentioned the uses to which the dentist puts the electric motor, stating that for a standard, upright pedal drill from one-twelfth to one-eighth horse power was required while a small lathe took about one-sixth horse power. Either two or three cells of accumulators were used or the current taken direct from a lighting or power circuit. He has never found the small alternating current motor to give as good results as a continuous current one. To the oculist he recommends a frosted lamp with a Ries regulating socket, and for the opthalmascope four 8-c. p. lamps. Nose and throat specialists, who simply use cautery apparatus, can best obtain the large current necessary from a small transformer, if an alternating current system is available. For the removal of superflous hair a simple equipment of 10 cells of the large size Sampson battery is sufficient. The regular practitioner wants (1) current for small examining lamps and for cauteries, which is usually obtained from a couple of cells of accumulators or a bichromate plunge battery. (2) Current for galvanic work, for removing fibrous tumors, etc., for which are required 48 or 50 cells of Leclanche battery, a milliampere meter and a double collector switch such as made by Gaiffe of Paris. (3) Faradic current for rheumatic and paralytic patients, which can be obtained from many of the Faradic portable batteries with induction coils, or sometimes the coil alone is used, connected to two or three cells of Leclanche battery from the Gaiffe outfit. (4) Mild continuous current for nervous diseases, obtained the same as for (2) except that in addition to the Gaiffe collector an adjustable rheostat, an interrupting button and a double arm switch for a pole-changer is required. A direct current of 110 volts, a rheostat and one or two cells of accumulator would replace all this cumbersome apparatus. For a physician's use in Montreal, where the available currents are a 52-volt alternating and a 250-volt direct, Mr. Shaw suggests the following arrangement: Let the 250-volt current run into the basement of the doctor's house and be connected up to a motor-generator of the one-h. p. type which gives 500 watts at the secondary end. The primary would take 250 volts; the secondary would reduce it to 52. This motor generator would be operated by means of a switch and rheostat placed upstairs in the doctor's operating room above the basement. The 52-volt secondary direct current wires would go to the lower terminals of a double pole, double throw switch. The house circuit for lights, etc., would come to the connecting knives or central contacts of the same switch, and the 52-volt alternating current should be run in and connected to the upper contacts of the same switch. The motor-generator could be left running during the daytime. The main switch would be down. There would be sufficient current for house lights, charging accumulators, running cauteries, motors, Faradic coils, galvanic current, etc., from it, and as a reserve he can throw up on to the alternating current, which can still continue to light his house lights, work his cautery, this time by means of small transformer.

In the discussion which followed Mr. Lockwood gave some amusing experiences of his with magnetic hair brushes. It was also maintained by others that the plan proposed by Mr. Smith was not perfectly safe where a high tension wire fell across an ordinary main. Mr. Smith claimed, however, that the battery system was also dangerous, for a wire was likely to corrode and the patient receive quite a severe shock.

"Electrolysis" was the subject of a paper by Mr. Jas. A. Baylis in which he presented a careful resumé of the whole subject, giving the experience of the New England Telephone and Telegraph Company at Boston, the results of the experiments of Prof. D. C. Jackson, and some of the various remedies which have been suggested and tried. The only sure cure for this trouble, he stated, was the adoption of some other system than the single trolley, such as a double trolley system, a storage battery or conduit system, or alternating currents, if a practical motor is found. With the single trolley, absolute protection is impossible, but to insure the greatest freedom from destructive action the track circuit must be of the lowest possible resistance, which means the best of bonding and frequent cross-connection of rails. The rail circuit should be reinforced by overhead returns connected to the rails at intervals. The negative pole of the dynamo should be grounded and the various systems of underground pipes connected to it by conductors of large carrying capacity.

From the discussion it appeared that gas companies as a rule had little to complain of. The destructive action is chiefly confined to the leading sheathing of telephone cables, etc. Mr. Lockwood stated that in Boston a very pronounced improvement followed the introduction of a copper return wire an inch in diameter. It was thought that in a small street railway system there was not much trouble from injury to pipes, but it was agreed that in large cities the best known methods for protection should be adopted.

Mr. L. M. Pinolet read a paper on "Alternating Motors," presenting an interesting resume of the subject. He stated in a simple manner the principle of multiphased motors and briefly traced their development, explaining the construction of a number of well-known types.

Considerable discussion followed the reading of the paper, there being a wide difference of opinion as to whether mutiphased motors were yet in commercial use.

After the reading of Mr. Pinolet's paper the committee appointed to consider the membership fees, reported, recommending a reduction of the active membership fee from $5 to $3 per annum in the belief that an incresae of membership would result. The report was adopted and the convention adjourned for the day.

In the evening the members, through the courtesy of Mr. Paige, managing director of the Packard Electric Company, attended a performance of the "'Black Crook" at the Queen Theatre.

On Thursday morning at 9.30 the members of the association met at the Mechanical Engineering Building of McGill University and under the guidance of Prof. Carus-Wilson inspected the dynamo room and electrical laboratory and witnessed a practical test on a transformer for the measurement of the power of an alternating current. The Convention assembled at 11 A. M., and Mr. E. Carl Breithaupt then read a paper on "Municipal Electric Lighting," presenting the various arguments in favor of private ownership and illustrated by examples drawn principally from Mr. M. J. Francisco's collection of data. The conclusion is that while in towns which are not large enough to make the business remunerative, the installation of a plant by the corporation may be justified because street lighting is a public necessity, where private plants already exist that are able and willing to supply the municipality at a fair price, the outlay cannot be regarded otherwise than as an unnecessary expenditure and a waste of public money.

The paper was discussed at some length by M. J. Francisco and others. Mr. Francisco considered it impossible for municipalities

to satisfactorily run their own lighting plant on account of the lack of honesty and integrity on the part of those in control of the public business.

On reassembling after an adjournment for luncheon Mr. D. H. Keeley described at length "A Method of Distribution with Equalization of Potential Difference," which, he claims, admits of a saving of 50 per cent. in copper if used in the two-wire system. Two sources of E. M. F. are required, and one loop of the exterior circuit connects the two + poles, and another loop the two minus poles. That is, a line starts from one + pole, passes through the distributing area and returns to the + pole of the other source of E. M. F., and the − parallel line (lamps being connected between the + and − parallel lines) is similarly connected to the two − poles.

This paper gave rise to a spirited discussion which the president was compelled to close for lack of time.

Mr. Higman, of Ottawa, made a few remarks on the electric light inspection act, touching on the clauses dealing with the insulation of consumers' wires, the limitation of variation of the voltage, the illumination of the lamps and the inspection of meters.

In a "Note on Possible Reduction of Station Plant on Small Electric Railways by Multiple Series Control of Motors." Mr. John Langton gives the advantages of the multiple series method for small roads. In starting, by throwing the motors in series the same traction is obtained with half the current from the line used with the motors in parallel. In starting, and getting up to speed in the same length of time, the power consumption is about two-thirds that of the parallel method. The same results can be obtained by using the multiple series control for going up grades, if we are content with a reduced speed. The total power consumption is the same, but the maximum demand on the power station from any one car is reduced nearly one-half. On small roads this means an actual reduction in the size of the station plant. On large roads the saving would not be so material, as with any system of control the principle of averages can be relied upon to a great extent to reduce the station capacity, and furthermore speed is there generally an important consideration.

At the close of the session about 60 members availed themselves of the invitation of the Montreal Park and Island Railway Company for an excursion to Back River, where they were conveyed on two special cars. The annual dinner of the association was held at Polaquin's Hotel. President J. J. Wright presided, and after the toast of "The Queen" had been honored, that of "Sister Societies" was proposed and reasponded to on behalf of the National Electric Light Association by President M. J. Francisco, who expressed the hope that the time was not far distant when the American and Canadian associations would be one. He trusted that the matter would be considered by the Canadian Association and extended to its members a hearty invitation to attend the next convention of the National Electric Light Association. Mr. T. D. Lockwood also made a happy response to the toast, speaking of the growth of electrical societies during the last decade, and stating that there had never been a time when the societies of the United States and Canada had been on so firm and satisfactory a basis.

Mr. H. Marple responded to "The Montreal Park and Island Railway Company," and Mr. A. M. Wickens to "The Stationary Engineers." After a few remarks by L. B. McFarlane the meeting adjourned to an upper hall and spent an hour or two in song and story-telling.

Friday morning was devoted to the reading of the remaining papers on the programme.

In a paper on "The Possibility of Securing Better Regulation at Central and Power Stations by Means of Fly Wheel Accumulators of Improved Construction." Mr. John Galt advocates the use of fly wheels in order to provide for the peak of load curves and thus reduce the investment in machinery and also secure better regulation. The theory of the fly wheel is gone into at length and its application to cases in electrical working illustrated by examples. A new type of fly wheel invented by Prof. Sharp, of England, is discussed very fully and its mathematical theory gone into in detail. The Sharp fly wheel is constructed on the same principle as bicycle wheels, the spokes being tangential, not radial, to the hub, which has helical grooves; one rod makes two spokes, the loop fitting into the groove. In a wheel illustrated there are 24 spokes, or 12 loops and a helix in the hub corresponding to 3 threads of a screw on each side, or 6 threads in all. The ends of the spokes are secured to the rim in one plane, being held by bolts.

Mr. F. J. F. Schwartz read a paper on "Cable Construction and Cable Faults," in which he sketched the development in telephone cables, described the various forms of cables that have been and now are used, the method of suspension of aerial cables and of the laying of the underground lines, etc. A number of interesting exhibits of pieces of cables were shown, illustrating the many forms of injury to which the cable lead is subjected; in one case a slight cut had developed into a large opening, in another a wire resting against the lead covering had sawed into the cable; while in others contact with a trolley wire had produced serious burns.

The paper by Mr. T. R. Rosebrugh on "Duplex Telephony," will be found in abstract elsewhere in this issue.

THE ATTENDANCE.

Among those present were President Francisco and Secretary Porter, of the National Electric Light Association, of the United States; T. D. Lockwood, Boston; W. B. MacLaughlin, of THE ELECTRICAL WORLD, New York ; Jas. J. Wright, Toronto; K. J. Dunston, Toronto; John Carroll, Montreal; C. H. Mortimer, Toronto; W. B. Shaw, Montreal; H. O. Frost, Peterboro, Ont.; D. A. Star, Montreal; George Black, Hamilton, Ont.; A. S. Smith, Toronto; L. B. McFarlane, Montreal; T. B. Rosebrugh, Toronto; E. C. Breithaupt, Berlin, Ont.; John Yule, Guelph, Ont.; Thos. Ahearn, Ottawa; Wm. Bourne, Toronto, H. A. Brown, Montreal; Robt. Dickinson, Toronto; John Langton, Toronto; F. Thomson, Montreal; Jas. Burnett, Montreal; W. A. Scott, Napanee; Jas. Green, Montreal; F. J. Schwartz, Montreal; J. A. Baylis, Toronto; L. W. Pinolet, Montreal; G. H. Keeley, Ottawa; Prof. C. A. Carus-Wilson, Montreal; R. J. Moles, Arnprior; C. E Arnoldi, Ottawa W. G. Slach, Montreal; Geo. Taylor, Peterboro; Robert Jones, Montreal; O. H. Hegman, Ottawa; J. T. Tower, Toronto; C. R. Brown, Ottawa; J. Kamerer, Toronto; D. C. Dewar, Ottawa; W. H. Wiggins, Montreal; C. A. Bissett, St. Johns, Que.; Charles F. Medbury, Ottawa; Charles Paige, Montreal; M. White-Fraser, Toronto; Wm. Mackay, Renfrew; A. A. Wright, Renfrew; A. Marples, Montreal; K. J. Daneta, Toronto; J. Black, Hamilton; J. J. Carroll, Montreal; A. C. McKens, Montreal; A. B. Smith, Toronto, and A. Langton, Toronto.

Annual Meeting of the New York Street Railway Association.

The twelfth annual meeting of the Street Railway Association of the State of New York was held at Syracuse, N. Y., on Tuesday, Sept. 18th, 1894. President D. B. Hasbrouck presided and delivered the opening address. He congratulated the Association upon the progress made during the past year, notwithstanding the pressure of the times, and made some happy remarks about the place of meeting, closing with a tribute to the memory of the late William Richardson.

The report of the Executive Committee, which was then presented, showed that the membership now consists of 30 companies, the highest number ever reached. It called attention to the special reports presented at this meeting and extended a greeting to the Michigan Street Railway Association, recently organized. It also announced that in order to enhance the value of the work of the Association Mr. C. J. Bissell, of Rochester, N. Y., had been secured as special counsel to attend to street railway interests during the annual sessions of the Legislature. The report closed with obituary notices of William Richardson, H. W. Slocum and H. F. Drayton.

According to the report of the secretary, which was next in order, the receipts for the past year were $5,860.09, while the expenditures were $5,381.20, leaving a balance of $478.89.

Mr. J. B. Craven then read an interesting paper on "Economy in Electric Power," an abstract of which will be found elsewhere in this issue. Some discussion followed which was participated in by Messrs. Cole, Craven, Seeley and Issertel. The paper of Mr. Geo. E McNulty on "Recent Improvements in Cable Traction" was next read. This embodied a large amount of interesting information in regard to improvements in cable traction embodied in the Broadway cable line, New York City. A voluntary paper was then presented by Mr. Allen R. Foote, of Washington, D. C., in which the author treated in a very interesting manner the subject of "Taxation."

The election of officers was next in order and the nominating committee made the following report: President, G. Tracy Rogers, Binghamton; first vice-president, John H. Moffitt, Syracuse; second vice-president, William W. Cole, Elmira; secretary and treasurer, William J Richardson, Brooklyn; executive committee, D. B. Hasbrouck, New York; John N. Beckley, Rochester; Daniel F. Lewis, Brooklyn. Albany was selected for the next place of meeting. The report was approved and the meeting then adjourned.

Exhibits were made by the following companies: H. W. Johns

Manufacturing Company, Consolidated Car Heating Company, Taylor Electric Truck Company, Cutter Electrical Manufacturing Company, Davis Automatic Car Shade Company, and the Peckham Motor, Truck and Wheel Company.

In the afternoon the visitors were driven around the city and shown the various points of interest. An inspection was made of the new track being laid by the Syracuse Street Railway Company. In the evening a complimentary banquet was tendered to all in attendance and was a very pleasant affair.

Gas and Electricity.

A rule given by Mr. Preece for comparing the costs of gas and electricity for lighting, is as follows: "Gas at three shillings (about 75 cents) per thousand equals electricity at sixpence (about 12 cents) per unit (kilowatt-hour)" or in other words, that the factor is about six.

Duplex Telephony.*

BY T. R. ROSEBRUGH.

After explaining the difference between a telegraph and a telephone circuit and giving the reasons why a single metallic conductor with earth connection at each end will transmit simultaneously four messages when used on a telegraph circuit, yet will only suffice for a single conversation as a telephone line, the author states that since two wires are necessary for the proper transmission of one message by telephone it might hastily be asumed that this is a constant ratio; that is, that the conductor, must always be twice as many as the number of messages that are to be transmitted simultaneously. The fact is, that it is the difference and not the ratio that is constant. There is no doubt, for example, that if it were necessary, ten messages could be transmitted simultaneously by eleven conductors without interference, although in that case it is exceedingly doubtful whether the complexity of the system would not preclude its use.

The most natural way of proceeding to increase the transmitting capacity of telephone conductors is to regard the already existing two-wire metallic circuits as the units out of which to construct metallic circuits of a higher order, which may be termed derived circuits.

It is necessary then that two points be obtained on a two-wire metallic circuit, satisfying the condition, firstly, that no difference

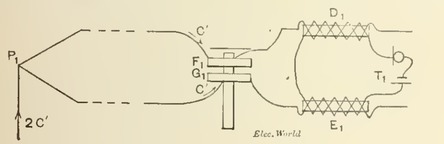


FIG. 1.

of potential be produced between them by the action of the transmitters already in that circuit, and secondly, that no effect be produced in the receivers of the circuit by the entrance and exit of current at these two points. The first condition may be satisfied in two ways according to the arrangement of the instruments already in circuit. If intermediate transmitting instruments are to be in series they must be divided into two similar parts, one in each line as in Fig. 1 are D and E, two secondary coils of transmitter T_1, arranged so as to contribute at each instant electromotive forces equal and in the same sense with regard to the metallic circuit, and therefore in opposite directions with regard to the line.

If the two sides of the metallic circuit have the same resistance it will be seen that no difference of potential can be produced between the points where the two lines unite, as in Fig. 1 at P_1, and the corresponding point at the other end of the line. If, however, the transmitting instruments are only at the terminals or are bridged across between the two sides at intermediate stations, as in Fig. 2, no such modification in their structure is necessary, for their action cannot produce any difference of potential bewteen points which are at the middle of any bridges between the lines.

It is not true, as might at first be supposed, that every bridge has a middle point, for such a point must divide both the resistance of the bridge, and its inductance, if there be any, into two equal part, and there will not in every case be such a point. In the case of a secondary of a repeating coil it will be necessary also that the two parts have equal mutual inductance with regard to the primary before the point between the two coils satisfies the condition of having the mean potential at every instant.

Since in any case the currents introduced on the lines of a two-wire metallic circuit must divide equally and flow parallel to one another in the same direction, we find the condition that the receiving instruments of the original metallic circuit should not be disturbed by such currents to be, either that the currents should not flow through the coils at all—which may be attained by bridging them between opposite points on the two lines; or, if the introduced current on one line flows through a coil of the receiving instrument, then that on the other line must flow through a coil in the opposite direction, which is just capable of neutralizing the magnetic effect of the first. As for instance in Fig. 1, the introduced current $2c'$ entering at P_1, divides into two parts c1, which circulate in opposite directions through the coils F_1 and G_1 of the receiver, and produce no effect, and similarly also in the coils F_2 and G_2 on the same line. Supposing the bridge method selected as being applicable more generally, let us look at the different ways in which it may be carried out. In Fig. 2, L_1 and L_2 are two lines which are supposed to be already in use as a metallic circuit, T_1 and S_1 being the transmitter and receiver at one end, and T_2 and S_2 at

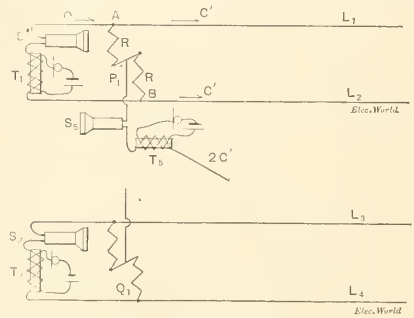


FIG. 2.

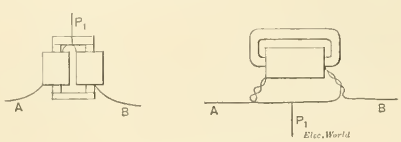
the other. L_3 and L_4 are similarly two lines of another metallic circuit. Between the points A and B are connected in series two equal non-inductive resistances R. At their common point P_1, a wire connects through telephonic apparatus T_5 and S_5 with P_2, a similar wire on the same metallic circuit, including also at the second end the telephonic apparatus T_6 and S_6; or it may connect with Q_1, which is a similar connection on the second metallic circuit, and similarly P_2 with Q_2, both connections including telephonic apparatus. Each of these bridges has then a resistance $2R$, but owing to the line resistance it would be generally incorrect to say that they are equivalent to a single shunt of resistance R. The current on the derived circuit passes through the coils of each pair of resistances in multiple, and each is therefore equivalent to $\frac{1}{2}R$. It is to be noted that currents arriving at A and B from P_1, on the derived circuit, do not divide at these points as might be supposed, but that portion of the circuit at the end between A and B, including T_1 and S_1, is left entirely dead, since, due to such currents, there is no difference of potential between A and B. The same thing applies also to T_2 and S_2, and to any other telephonic apparatus of this circuit bridged across between L_1 and L_2, which is not provided with an exit at its middle point.

As a first improvement on this construction it may be suggested that a self-inductive resistance would be better than a purely ohmic resistance, if not connected exactly at the ends of the line, for it would partly compensate the effect of electrostatic capacity between the wires.

The next step in advance is to put the two coils R together on the same core as in a telegraph relay, Fig. 3, so that while the leakage current passing from A to B through the two coils in the same direction around the core, reinforces the magnetism of the core and experiences consequently a high impedance, that from the derived circuit which enters at P, the middle point, and divides there, passing in opposite directions around the core in the two coils, affects the magnetic circuit comparatively little, and has therefore low impedance. In the case of an ordinary box relay of 150 ohms we would have in series from A to B a resistance of 150 ohms, and an inductance of 4.8 henrys, while from P_1 to A and B in parallel we have $37\frac{1}{2}$ ohms and .49 henry, or to the note "middle C" an impedance of about 7,730 ohms to currents leaking through its coils in series, and 790 to the derived currents dividing from the middle

* Abstract of a paper read before the Canadian Electrical Association at Montreal, Sept. 21, 1894.

point outwards, making a total impedance of 3,160 ohms in addition to the ohmic resistance of the derived circuit. Better results than this could be obtained by superimposing the windings instead of having them on separate limbs of the magnetic circuit. The best possible results, however, will be obtained when the derived current forking at P_1 to A and B traverses practically identical courses in opposite directions around the magnetic core, and has therefore a non-inductive path, while the leakage current from A to B passes over this course twice in the same direction, experiencing the maximum impedance. This may be accomplished most exactly by twisting the wires together and winding the double conductor on the coil. A coil made in this way, Fig. 4, measured 480 ohms and 4.6 henrys to the leakage current, or an impedance of about 7,400 ohms to the note "middle C," while to the derived current entering at its middle point it was practically a non-inductive resistance of 120 ohms. In good modern construction it is necessary on circuits of moderate length to transpose the wires on the poles, in order to expose them equally to outside disturbing influences. In addition to this transposition, to get the best results it is often desirable to transpose the circuits among themselves; this transposition of the metallic circuits is more necessary when derived circuits are formed



FIGS. 3 AND 4.

from them, for in that case transposition on the poles is as important as it is for single conductors to which they are then equivalent. For this reason the derived circuit should not be applied to a pair of circuits differing materially in length.

The underground cable system connecting stations in the same city affords an excellent opportunity for the application of the above principles, for a large number of metallic circuits between the same two points are in continual demand and are quite expensive. A redistribution of the positions of the wires in the cable being made at every manhole, the transposition must be quite thorough.

Coils such as are indicated in Fig. 4 have been in use in Toronto for some time on the cable between the main office and the Yorkville station; they afford an extra speaking circuit for each pair to which they are applied, in which as well as in the two original circuits, speech is perfectly transmitted. The same thing is true of a pair of metallic circuits between Toronto and Hamilton, when the circuits are free from long extensions.

It appears quite probable that on very long lines the decreased conductor resistance and self-induction of the derived circuit as compared with the originals would fully counterbalance the increased electrostatic capacity and give, for example, between New York and Chicago, three speaking circuits for every four conductors, instead of two, the transmission being unimpaired in any of the circuits.

Economy of Power-House Operation.*

BY J. B. CRAVEN.

Mr. Craven believes that it is in the boiler-room where in most cases the greatest waste will be found. It has been said that the waste due to improper firing is often of greater consequence than any other loss which is produced in the operating of a steam plant. There are two causes for this: First, poor construction of the boiler. Second, poor firing and lack of care of the boilers. Many think that any man can fire a boiler, and whilst looking with awe and wonder at the engine and generator, forget that all the power comes from the coal pile and pay little attention as to the economy in transmitting that power from the coal to the engine. No greater mistake is made than to place the care of boilers in incompetent hands, for they require the highest degree of care, conscientiousness and constant attention.

The fireman must be ever on the watch to see that the water is kept at the proper level, to keep an even steam pressure, and to show by his steam, coal and water records that he is getting just as good cards as the engineer can show by the manipulation of the steam he uses in his engine. He must see that the fires are spread evenly over the grates and are of an even thickness, that the proper amount of air is admitted into the furnace to obtain good combustion. When it is realized how easily from 1 to 20 per cent. of coal can be shovelled into the furnace and up the chimney without generating any more power, the importance of having something more than mere machines shovelling coal into a furnace becomes evident. Another point of importance is to see that the boilers are kept clean and free from scale, which is simply the result of improper attention. Boiler scale not only causes loss of heat, but by leaving the iron exposed to the effects of the heat without the proper circulation of water back of it, causes rapid deterioration, and in some cases an explosion. Mr. Craven states that he has used quite a number of boiler compounds for the prevention of scale, but has found the best to be plain coal oil. This has been used in Buffalo for the past two years with success, putting about one pint a day into each boiler and letting it enter with the feed water by means of a sight feed lubricator. No one remedy, however, will fill all cases, and each must be the subject of some experiment.

As to feed-water heaters, if engines are running non-condensing, the question is very easily settled; as, however, the majority of steam plants are run condensing, other factors are brought in. In the power-house of the Buffalo Railway Company one-seventh of the engine capacity is run high pressure. In this way, taking the feed water from the hot well, at an initial temperature of 110 degrees, and passing it through two heaters in the exhaust of the high pressure system, a final temperature of 19 degrees is attained before the water enters the boilers. It is claimed by some that this method of taking water from the hot well is not right on account of the oil to be found in this water. But so small a portion of the hot well water is used, that the amount of oil in it is small, and by this method secondary heaters are done away with in the exhaust between the engine and the condenser, and not only save in the first cost, but slightly better results are obtained. However, one thing is important, whatever means are used to heat the feed water, it should be done, for not only will there be a great saving in fuel, but the straining of the boilers due to putting cold water in, will be done away with.

Passing from the boiler room to the engines and generators, it is evident to all that where the space is valuable the direct connected unit has the advantage of taking up less room. They can be thrown in and out of service with as much rapidity as the belt driven machine; there is a saving of from 1½ to 3 per cent. due to the slipping of belts, very little in itself, but when figured up at the end of the year in a plant of any size will amount to considerable. Added to this there is the saving in labor and the decreased expense due to wear and tear, as this item is less in slow speed than high speed machinery. For the above reasons Mr. Craven draws the conclusion that direct connected units are more economical than high speed ones. Regarding the size of units used, it depends entirely on the output of the plant, but they should be as large as possible, yet not so large that the breaking down of one would cripple the traffic. However, in plants that have not these latest types of machines, great savings may be made in the operating of the engines. In many cases after the constructing engineer has left, engines are oftimes supposed to look after themselves, those in charge simply supplying them with steam and oil. What has been said in reference to the man in charge of the boiler-room applies with equal force here. A thoroughly competent man in charge will be a paying investment. Intelligence and experience are the best safeguards and the real insurance against accidents. Fifty dollars a month more to a capable engineer will probably be repaid a hundred times by the care taken and the high state of efficiency in which the machinery is kept. In such a state an engine is a reliable piece of mechanism. If neglected it is liable to fail at any time, causing delays and worries, and not only adding to the expense in the cost of repairs, but a loss in the receipts outside.

A capable engineer will see that his engines are indicated at least once a month, to see that the valves are properly set and so keep the steam consumption down to a minimum. All pounding, knocking, and leaks should be followed up and remedied at once, and the engines kept in such a state as at all times to be ready to perform the severest service exacted from them. Always keep the load as near the normal capacity of the engines as possible, as engines at that point are most economical; besides, you will have fewer machines in service and thus save in the oil supply. Quite a saving may be made in oil, and an instance is cited of one engineer who used $640 worth of oil more in six months than another engineer in the same time, and the engine capacity was increased during the time the last man was in charge. The lowest priced oil is not

*Abstract of a paper read at the twelfth annual meeting of the New York State Association, September 18, 1894.

always the cheapest; some oils will go much further than others, and the question of what to use should be settled only by careful examination. After being used once it can be filtered and used again on the lighter parts of the machinery. If rags are used for wiping instead of waste they can be washed and used again, and the grease and oil extracted will be found useful in some part of the system By washing the rags 80 per cent. can be saved over what the cost would be if only used once and thrown away. The generator should be kept dry and thoroughly clean, and the commutator kept as smooth as possible. The principal trouble will be found in the sparking of the brushes and the heating of the armature and the field coils.

Electrodynamic Machinery—IX.

EDWIN J. HOUSTON AND A. E. KENNELLY.

43. Besides the case of the anchor ring, represented in Fig. 44, the magnetic circuit of which being entirely confined to the interior of the coil, permits its reluctance to be readily calculated and the flux to be arrived at, another case, almost as simple, is found in a long straight helix of length l cms., uniformly wrapped with n, turns per cm. or $N = l\,n$, turns in all. Such a helix, when excited by a current of I, amperes, develops a M. M. F. of $n\,I$ ampere turns, or $1.257\,n\,I$ gilberts per centimetre, or $1.257\,N\,I$ gilberts for the total M. M. F.

The magnetic circuit of such a solenoid is roughly represented in Fig. 21. An inspection of this figure will show that flux passes through the interior of the helix in parallel streams, until it reaches a comparatively short distance from the ends, when it begins to sensibly diverge, and, emerging into the surrounding space, is diffused through widely divergent paths. That is to say the magnetic circuit is characterized by two distinct regions; namely, that within the coil, where the flux is uniform, and, except near the ends of a maximum intensity, and that outside and beyond the ends of the coil, where the flux is divergent and greatly weakened in intensity.

44. In the case of a long, straight, uniformly wrapped helix, the reluctance of the circuit may be considered as consisting of two distinct portions; namely, a straight portion occupying the interior of the coil and lying practically between the ends, and a curved or diffused portion exterior to the coil. The reluctance of the first or interior portion will be practically $\frac{l}{a}$ oersteds, where a is the cross sectional area of the coil in cms. and l, the length of the coil in cms., or more accurately the reduced length of the non-divergent flux. It will be seen, therefore, that the interior of the coil behaves like a straight wire carrying electric flux, since it practically confines the flux to its interior, and, that this particular portion of the magnetic circuit is similar to the case of the anchor ring above referred to, where the magnetic flux is confined to the interior of the ring.

Since the external circuit possesses diffusion, its reluctance cannot be so simply expressed. Its value, however, may obviously be dealt with as follows: although the mean length of the flux paths outside the coil is greater than in the interior portion, yet the area of cross section of the circuit is enormously extended. It would appear, therefore, that in the case of an indefinitely long straight coil, the external reluctance becomes negligibly small compared with the internal reluctance, and may be left out of consideration. In such a case, therefore, the flux established

$$\Phi = \frac{1.257\,l\,n\,I}{\frac{l}{a}} = 1.257\,n\,I\,a \text{ webers,}$$

and since this flux passes through a cross sectional area of a square centimeters, within the coil, the interior intensity will be

$$\mathfrak{B} = \frac{1.257\,n\,I\,a}{a} = 1.257\,n\,I \text{ gausses.}$$

Strictly speaking, therefore, this is the intensity of flux within an indefinitely long straight helix and is approximately the intensity within helices which have lengths more than 20 times their diameter.

45. We have now discussed two cases of non-ferric circuits whose reluctance is readily calculated; namely, a closed circular coil and a long straight helix.

In all other cases, the reluctance of the branching and divergent paths is much more difficult to compute, although the fundamental relations remain unchanged.

When the magnetic circuit is non-ferric, although the reluctivity of the circuit always equals unity, yet, owing to the difficulty of determining the exact paths followed by the divergent flux, the reluctance is difficult to determine.

Most practical magnetic circuits, however, are composed either entirely, or mainly, of iron. At first sight the introduction of iron into the circuit would appear to make the reluctance more difficult to determine, because the reluctivity of iron not only varies greatly with different specimens, but also with its hardness, softness, annealing, or chemical composition. Moreover, the apparent reluctivity of iron varies markedly with the density of the flux passing through it. Iron, when magnetically saturated, possesses a reluctivity equal to that of air; while, as we have seen, at low intensities the reluctivity is much smaller, and may be several thousand times smaller.

Since, however, ferric circuits, as ordinarily employed, practically confine their flux paths to the substance of the iron, and, since the reluctance of the iron is so much less than the reluctance of the alternative air path outside, the air flux may usually be neglected. Even where, owing to the reluctance of the air gaps in the circuit, such as in the case of dynamos and motors, a considerable amount of leakage or diffusion may take place, yet it is preferable to regard this leakage as a deviation from the iron circuit, which may be separately treated and taken into account, and that the flux passes principally through the iron. For these reasons ferric or aero-ferric circuits, at least in their practical treatment, are simpler to determine and compute than non-ferric circuits, since, although their reluctivity is variable, yet the geometrical outlines of the flux paths can be regarded as limited, and the reluctance of these paths readily can be determined.

46. Magnetizing force may be defined as the space rate at which the magnetic potential descends in a magnetic circuit. Since the total fall of potential is equal to the M. M. F. in the circuit, just as the total "drop" in a voltaic circuit is equal to its E. M. F. Consequently the line integral of magnetizing force in a magnetic circuit must be equal to the M. M. F in that circuit. In other words, if we multiply the rate of descent in potential by the distance through which that rate extends, and sum all such stages, we arrive at the total magnetic potential descent. For instance, in Fig. 44 the total

FIG. 45. IRON RING PROVIDED WITH AIR-GAP, AND WOUND WITH WIRE.

difference of magnetic potential is 1005.6 gilberts, which, by symmetry, is uniformly distributed round the entire circuit. Since the mean length of this circuit is 60 cms. the rate of fall of potential is $\frac{1,005.6}{60} = 16.76$ gilberts per centimetre all round the ring, and this is therefore the magnetizing force. This magnetizing force is usually represented by the symbol $\mathfrak{H}$, and when no iron or magnetic metal is included in the circuit, is identical with the flux density $\mathfrak{B}$, so that $\mathfrak{H}$ is expressed in gausses. The term magnetizing force was adopted from the less recent conception of magnetic poles; for if a pole of unit strength could be introduced into a flux of intensity gausses, the mechanical *force* exerted upon the pole would be $\mathfrak{H}$ dynes, directed along the flux-paths. In any magnetic circuit, if we divide the M. M. F. in gilberts by the length of a flux path we obtain the average value of the magnetizing force (or flux density in the absence of iron). Thus, in Fig 21, if the long helix there represented has a M. M. F. of 5000 gilberts, and a particular flux path has a length of 500 cms, the mean flux density, if there is no iron in the circuit, and the mean prime flux density or magnetizing flux if there is iron, will be $\frac{5.000}{500} = 10$ gausses. The intensity outside the coil will usually be considerably less than this, and the intensity inside the coil considerably greater.

(To be continued).

Electricity in Berlin.

For the assistance of the members of the Verein Deutscher Ingenieure in their visits of inspection about Berlin during the recent meeting of the Verein in that city, a volume of 300 pages had been prepared containing a series of articles by well-known specialists, giving clear and practical descriptions of the most interesting engineering features of the capital city. From this book the following is abstracted, relating to electric lighting, the telephone and telegraph:

It is shown that from 1885 to the present time the current output for house lighting has increased from 635,800 to 94,000,000 normal lamp hours, and for street lighting from 50,890 to 400,000 normal lamp hours, while the number of lamps connected has grown from 4,900 to 203,050. From 1889 to the present time the energy consumed by small motors for industrial purposes has risen from 12,956 to 575,000 kilowatt-hours.

On a yearly average one kg of coal burned in this plant gave regularly 560 watts of current at the point of consumption, a result which has probably not been reached by any other central station in the world.

The Berlin telephone system was opened on the 1st of April, 1881, with 33 subscribers. At the end of 1893, the number of subscribers amounted to 23,420, divided among six large exchanges. On account of this great number, there was made last year a change from overhead conductors to a mixed system of running the wires. Starting from the exchanges, the conductors are run underground for a distance of about one km and thence carried overhead to the individual subscribers. Besides this, a large number of connecting wires between the different exchanges are laid entirely underground. The conduit network which was put down at the time, was calculated for an increase to 40,000 subscribers; it was thought then that the requirements had been greatly exceeded, but the day is not far distant, when at least part of the system will have to be enlarged. Bronze wires, 1.5 mm in diameter, are principally used for overhead conductors; the wires are carried exclusively on supports of double flat-iron, attached to stands made of iron tubes with sides 5 mm. thick, which are fastened and anchored to the house ridges. The distance between the poles is usually 150 m; as as protection against lightning, every rod is connected with four galvanized iron wires, each 4 mm in diameter, which lead to a gas pipe, of 10 cm. internal diameter, which serves as an earth plate. In order to prevent the conductors from vibrating, there are used rubber cylinders, 15 mm thick and 10 to 15 cm long, which are split open and surrounded for their entire length with strips of tin 0.5 mm thick, fastened with binding wire.

The telephone cables used are 32 mm in diameter, contain 28 conductors and weigh 4 kg per meter. They are laid in round, cast iron jointed pipes, asphalted inside and out, 200 to 400 mm in diameter and about 80 cm beneath the surface of the street.

On the 1st of January, 1894, the length of the overhead wires amounted to 40,980 km, and that of the undergrown cables to 603 km, with 17,469 km of conductors.

All the long distance interurban traffic is conducted from the main office on Franzosische Strasse. From this point 20 lines lead in different directions to Hamburg, Frankfort A-M, Liepzig, Breslau, Königsberg and so on. The longest line at present is the one to Königsberg, 676 km. Two somewhat longer ones are being built, Berlin to Vienna and Berlin to Munich.

The main telegraph office of Berlin is on Franzosische Strasse, where 345 lines end, 52 of which serve for direct foreign traffic, and the rest for domestic business. There are 133 telegraph offices in Berlin. Current is furnished by accumulators, which are charged partly by dynamos and partly by primary cells, 2,000 of the latter being now used for this purpose, instead of 13,000 as formerly. The number of incoming and outgoing dispatches at Berlin amounts in one year to thirteen million, which are taken care of by 122 sets of Hughes printing telegraph apparatus and 247 Morse recorders. Trials have lately been begun with sounders of American and English forms. The Hughes apparatus has a capacity of about 1,200 words and the Morse color recorder about 400 words over one wire, the line in either case being used for single transmission.

Experience as a Teacher.

In an editorial the London "Electrical Review," closes with the following remarks: "In the matter of publishing to the world their own mistakes our own engineers may take a lesson from Americans, whose society proceedings often contain frank admissions of the mistakes made by the speakers and the results thereof, and means taken to repair damages."

The Earth as an Electrical Conductor—II.

BY JOHN HENRY HOLT.

From the well plates, as also from the earth plates, were run short copper wires to a switch, by which arrangement, at the option of the experimenter, the ground plates could be used alone, the wells alone, or both in parallel or series.

The portion between the terminal stations is divided into five intermediate ones, each 500 feet from the other. Commencing on the right in the figure, they will be designated hereafter as station (1), station (2), and so on across the line. At these stations ground connection was made by driving down, flush with the surface of the earth, wrought iron rods, six feet long and two and a half inches square, to each of which was soldered a copper wire, which could be readily connected to the overhead line wire.

The figure represents a cross section of the earth included between the terminal stations and taken in a direction parallel to that of the line, though only to a limited depth. The portion under investigation, as well as all of the surrounding country, was once the scene of very active geological agencies, mainly aqueous. Very great erosive effects on the one hand, and the disposition of "drift" on the other, are evidences of the presence of such agencies.

Holes were dug at each station to a sufficent depth to ascertain the character of the soil penetrated by the ground connection at that station, and also by the aid of four wells along the line it was possible to locate pretty well the strata.

The depth to which the cross section is taken includes two geological formations. The top stratum seen at stations (1), (2), (4) and at (B), and covering all of the hill tops, consists of a drift deposit. It is variable in thickness, at (1) being from twelve to fifteen feet thick, and growing thinner, of course, as the hill sides are approached. At (B), however, it is not more than three feet deep. Stations (1), (2) and (4) lie entirely within this stratum—that is, the ground rods do not extend into the stratum directly underlying it. In this drift formation is found a great many rocks—water-worn pebbles—scattered throughout the highly silicious earth which composes it. In addition to the quartz pebbles, other foreign substances, as rutile and tourmaline, abound between stations (1) and (3) especially. The hill top at (4) is covered with iron geodes, they too being foreign, having probably been washed up with the rest. From the very nature of the case, this stratum is an exceedingly porous one.

The stratum directly underlying the drift is one of the older formations, probably Laurentian. That portion of it which surrounds the plates at (A) and (B), and also at the ground rod at (5), upon analysis was found to be a very red clay soil, containing a great deal of iron.

The fact that iron geodes (foreign) are numerous along the hill side between stations (3) and (4) does not destroy the assertion that the soil there contains a great deal of iron itself, but there may be seen the formations of the red clay soil in spots from the iron in situ.

The valley in which station (3) is located was once gorged much deeper than atpres ent, having been filled to a great extent by an alluvial deposit—washings from the adjacent hill slopes.

As is indicated in the figure, a small stream flows at right angles to the line in the valley on the left of (3). The stream is about three feet broad, and very shallow at the point of intersection with the line.

(1) To find the resistance between the two terminal stations (a) with earth plates used as grounds, we shall take first the case in which the current is obtained from a dynamo. The method adopted for finding resistance was simply to pass the dynamo current through the line, with a volt and ammeter in circuit, and, from their respective readings calculate the resistance by Ohm's law. A Weston voltmeter and Thomson's graded ammeter were used.

The current was switched on at 60 volts, and increased 10 for each subsequent reading, from 60 to 150 volts. At 60 volts and a current of .54 of an ampere, the resistance was found to be 111 ohms; for 70 volts, it was 112, and at 90 volts was 113 ohms; but at 110 volts and a current of 1.15 amperes, we find the resistance to be again 112 ohms. Carrying the voltage to its maximum, 150, and the current to 1.36 amperes, the resistance rises to 115. By taking the average of the ten readings, the resistance by this method is found to be 111.1 ohms. The variation in resistance as the current varies is at once noticeable; hence it is seen, as will be further demonstrated, that we cannot take one reading and affirm that it be the true resistance of that portion of the earth, for when the slightest change takes place our result no longer holds good. It is an instantaneous value of the resistance. Note that the plates at

both stations lie within the older formation, the soil at (B) containing more iron than that at (A).

The above readings having been taken, the earth plates were disconnected and the well plates switched in. The surrounding circumstances and apparatus used were the same as before. Current was turned on at 60 volts and .4 of an ampere, giving a resistance of 150 ohms; at 70 volts and .437 of an ampere, it increased to 160 ohms. Now, the resistance increased uniformly with increase of current up to 187.7 ohms at 150 volts and .8 of an ampere, the average of the readings being 174.9 ohms. These results show the resistance to be much higher when the plates are placed in water than when simply buried in the earth; also, that the resistance increased a great deal more uniformly when well plates are used. The well and earth plates were now connected in parallel, and readings taken as before. The first, which was taken at 60 volts and .65 of an ampere, gave a resistance of 92 ohms, and increasing in the next to 93, but at the next reading fell to 80 ohms, and from this reading to the last the resistance varied between 80 and 79 ohms, the latter being the last reading.

Here we meet an exception to our rule of increasing resistance with current in that the last reading gave a lower resistance than the first. I shall endeavor to explain this later, but the advantage gained in having earth plates and wells connected in parallel over using them separately is at once noticeable.

The above tests being completed the line was short circuited for a few days, in order to get rid of any of the effects of the dynamo current that might remain, then allowed to remain open for a day.

The weather about the same as before and no appreciable change in the condition of the soil as regards moisture at a depth of from three to four feet below the surface. The apparatus and method of measuring resistance were changed. The dynamo current was no longer used, three Daniel cells being substituted. A Wheatstone bridge with a very delicate reflecting galvanometer was employed.

The strength of the battery current could be varied by means of a resistance box in series with the cells. The extremes to which the

Disregarding the method employed, though not actually the same, all of the results are relatively the same. For example, under the first head the resistance when using wells with dynamo current was found to be higher than when using earth plates with same current. Now this is true whatever be the method employed for finding the resistance. One might suppose this high resistance of the first 500 feet to be due to the fact that the ground connection at (1) is not so good as that at (B), but when it is shown that the resistance between stations (A) and (3), a distance of 1,500 feet, is only 79.5 ohms, such a reason is at once insufficient.

Now, break the connection at (1) and connect ground at station (2) to the overhead wire, 1,000 feet from (A). By the same method as before the resistances were found to be 333.3, 355, 382.2 and 390 ohms; also higher than the whole portion, and as in the case just preceding, station (2) lies in the drift formation.

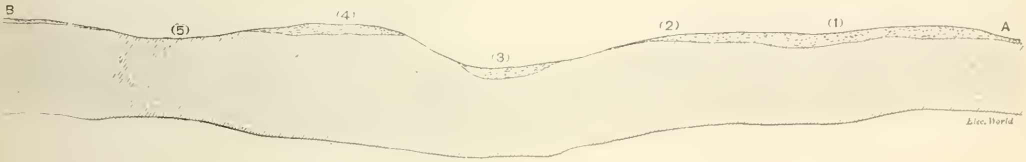
Hereafter, when it is stated that such a station is connected in, it is taken for granted that the one previously tested has just been disconnected. Station (3) is now connected in and quite a notable change takes place in the resistance, which was found to be only 63, 79.5 and 85.9 ohms. Station (3) is located in the valley, about thirty feet from the little stream. The ground connection at that station lies entirely within the alluvial deposit which directly overlies the older formation.

The portion between stations (A) and (2), a distance of 1,000 feet, has an average resistance of 381.6 ohms, while in the case above, a distance of 1,500 feet, we find the average resistance to be only 77.1 ohms.

Station (3) is damply located. Can we attribute the low resistance to that cause? If so, why is not the resistance between the well plates lower still, for here they are entirely surrounded by water?

These results prove very clearly the resistance of the drift to be much higher than that of the older formation.

Moreover, that there is a great advantage to be gained by placing ground connections in one stratum over placing them in another is at once evident and admirably shown by the following experiment, which I take from The Electrical World of April 14, 1894: "According to a daily contemporary, the Abbe Michel has succeeded in using two separate horizontal strata as a telephone circuit. The strata are conducting, and are separated by an intervening stratum of comparatively insulating material. By coupling the transmitter to a surface stratum and a deep stratum, and similarly coupling the receiver, it was found that speaking could be carried on at a distance of 120 feet. Very rarely would geological conditions permit of this arrangement being adopted, while in any case, of course, it would be impossible to have more than one system in the same locality."



CROSS-SECTION OF EARTH BETWEEN TERMINAL STATIONS.

resistance would vary was even greater in this than in the preceding case, when the stronger dynamo current was used. With earth plates as grounds, by varying the current strength for each reading, the resistance varied all the way from 65 to 106 ohms. This great variation in results is no longer to be wondered at, in this case especially; for when the current is reduced very low, the cause is at once seen. The galvanometer—an exceedingly delicate one—under such circumstances seems to become unmanageable. The mirror jumps spasmodically, as though some one passed a magnet quickly before it. The unreliability of results so obtained is at once evident, for there seems to be an extra current in the line which acts in opposition to or in the same direction as the battery current, as the case may be, and the results are altered accordingly. Placing the terminals of the line to those of the galvanometer after the battery current had been withdrawn, the presence of such a current was at once shown by the bold deflection of the mirror.

The earth plates were switched out and well plates connected, the resistance in this case varying from 78 to 131 ohms.

The wells and earth plates being now connected in parallel, the resistance under this condition was found to be from 63 to 70 ohms.

Of course, the same battery current and apparatus were used in all three of the preceding tests.

(2) To find the resistance between one terminal station and the successive intermediate ones: The most interesting features and by far the most important ones to my mind are brought out under this head. A few cells of storage battery were employed this time, the current strength being varied by same means as before, though, however, the same Wheatstone bridge was used as formerly. Before the results are given, note the location of the stations in the figure, (A) penetrating just into the old formation, while (1) lies wholly within the drift, the two in separate strata. The current strength being changed each time the resistances were 183.3, 195.5, 212.2 and 221 ohms respectively. Thus it is shown that the resistance of the first 500 feet is greater than that of the whole 3,000.

Proceeding as before, the resistances between stations (A) and (4) were found to be 514.2, 555, 561 and 583 ohms, an average of 555.3 ohms. Notice the high resistance of this section and the location of (4). It is on a hill top, 2,000 feet from (A), and entirely surrounded to the drift formation, which attains quite a considerable depth in that locality.

This though only confirms the previous statements about the relative conductivity of the strata. Finally station (5) is connected in and the resistances found to be 217, 237, 328 and 353 ohms, an average of 225.8 ohms.

Being 2,500 feet from (A) station (5) penetrates both formations; the drift though is only superficial.

(3) How the resistance is affected by the polarization of the plates: Thus far we have dealt only with the resistance of the earth between the terminal and intermediate stations. We were attracted by the great variation in the results and the presence of an extra current in the line. This variation in resistance of the same portion of earth while using the same apparatus is certainly not due to any inaccuracy of the instruments, for they were tested with known instances repeatedly before and after each test. Polarization of the plates and ground connections is evidently the cause, because the effects produced are in every respect identical with those produced

by polarization: (a) When using a small current, the resistance was a great deal lower than when using a strong current. (b) When a current was sent through the line a second one was set up and shown to be quite strong when the terminals were placed to a galvanometer. To illustrate, take the ideal case where the plates were wholly immersed in a liquid. After passing a current through the line of not more than an ampere in strength and applying the terminals to those of a galvanometer, of course, after withdrawing the exciting current, if such it may be called, the mirror was deflected 29 cm. on a scale 34 cm., away from the instrument. The direction of this current was noticed, and the exciting current sent through the line in an opposite direction. By this process the galvanometer mirror was brought to a zero position; that is, the instrument indicated no current in the line for the time being. The exciting current was again passed through the line, this time setting up a current which caused a deflection of 30 cm. on the same scale. The existence of so-called "earth currents" has long been known, but such an hypothesis is unnecessary in the present case.

The polarization effects on the intermediate stations is all the more noticeable. The case taken above to show the effects was an ideal one, as was stated, the variation from which will be shown in the following cases: For example, take the case in which stations (4) and (A) were used, on the hill top. The deflection after using the same exciting current as before, and for the same length of time, was only 3.5 cm., while, on the other hand, when (5) was connected in, a deflection of 17 cm. was produced; and, furthermore, when (3) was connected in the deflection was 26 cm. The deflections produced by connecting in stations (1) and (2) were almost identical, being 4 and 4.5 cm. respectively. A plate similar to those in the wells was connected to the overhead line, as were the ground rods, and placed in the stream near (3)—the water running briskly over the plate. The same exciting current was sent through the circuit, the plate in the stream forming one ground and the plate at (A) the other. Upon removing the exciting current no reflection could be noticed.

(4) Is the resistance altered by using alternating currents? If so, how and to what extent? What we wish to find is the resistance of a portion of the earth without the effects of some local causes at the grounds. Now that we have attributed these disturbing effects to polarization, it only remains to employ some means that will be independent of polarization. By the use of alternating currents such means may be had. A method used in getting the specific conductivity of electrolytes was employed. This consists of the same Wheatstone bridge as previously used, though substituting for the battery and galvanometer an induction coil and telephone receiver.

In getting the resistance by the above method no perceptible variation took place in the results as by former methods, so it will be sufficient under this section to simply state in a tabulated form the results as they were obtained.

Resistance of earth between ground plates (A) and (B)	92.4	ohms
" " " " well " " " "	121	"
" " " " well plates and grounds in parallel	66.8	"
" " " " Station (A) and (1)	201.6	"
" " " " " " " (2)	374.7	"
" " " " " " " (3)	92	"
" " " " " " " (4)	506.3	"
" " " " " " " (5)	180	"

These, it may be said, are the true values of the resistance of the several portions tested; though I do not mean to say that all of the results obtained before were inaccurate; they are, as it were, the instantaneous values of the resistance.

The resistance of the earth as found in these tests is much higher than it is ordinarily believed to be. The matter of making ground connections is one that greatly depends upon local effects, hence every precaution should be taken to secure the best advantages. These are not to be secured, however, by placing the ground terminals in water or by simply placing them in any soil that seems to be a damp one, nor by selecting the driest soil possible, but plates or rods should be located in good conducting strata, and it should by no means be assumed that the earth is anything like a perfect conductor.

Electric Brakes.

In a paper read at the September meeting of the American Institute of Electrical Engineers, Mr. E. A. Sperry discusses the qualifications necessary for a street car brake, and shows the superior manner in which these are supplied by an electric brake, of which a form invented by Mr. Sperry is described.

It is stated that nearly 85 per cent. of electric street railway accidents are due to the inefficient operation of brakes. With wheel brakes it is possible to bring a car to rest from a speed of 10 miles per hour within ten feet. The results of experiments on hand brakes are given, showing that with the full power of a man on hand brakes, exerting 180 pounds, a retarding effect of only 460 pounds can be developed, which is less than one-third that which is possible of being attained if the needful power were at hand, and which can be easily applied by electrical means.

The electrical brake invented by Mr. Sperry is illustrated in Figs. 1 and 2. The stationary part, shown in Fig. 1, is supported by the truck frame and centered on the wheel axle. When in operation it bears against a faced surface on the car wheel and brakes the latter, both through the friction due to the pressure of magnetic attraction and the torque created from the generation of eddy currents in itself and the wheel—the combination in this respect acting as a dynamo. In the grooves indicated in the cut is a coil of wire which receives current generated by the car motor acting as a dynamo after the trolley current is cut off and the brake lever is operated. In the opening of the brake ring is shown a graphite brush with which the braking surface is lubricated, it having been found by experiment that a greater braking power is thereby attained, due, according to Mr. Sperry, to the graphite through its conducting power permitting the eddy currents to circulate more freely between the wheel and brake ring surfaces.

The brake ring is so mounted, as shown in Fig. 2, that no weight whatever is supported by the axle, and all of the strain is borne by the truck framing; the method of support is such that gravity acts to retract the ring from the wheel face when current ceases to flow in the coil of the former.

The action of the brake is as follows: When the trolley current is cut off the moving car, the motor terminals, by means of the controller arm, are connected with the coil in the brake ring, the

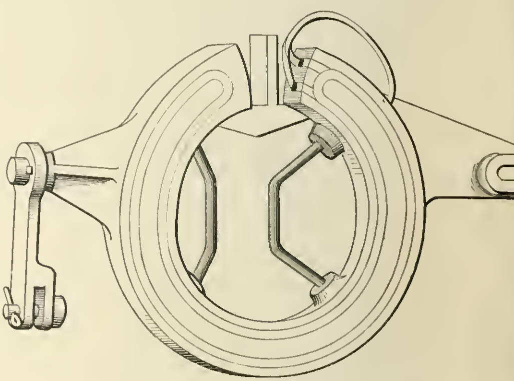


Fig. 1.—Stationary Part of Brake.

motor now acting as a dynamo. The current thus generated energizes the brake ring, which is then attracted against the wheel braking surface. The friction due to the magnetic attraction between the ring and the wheel retards the latter, and the wheel also acts as a magneto-dynamo armature in the generation of powerful eddy currents, thus creating a strong retarding torque. To this should be added the braking action of the motor acting as a dynamo, which, however, is small; a braking effect, for instance, equivalent to a pull of 2,432 pounds on a brake chain is produced by only 3½ volts at the motor, which voltage passes 16 amperes through the braking coil.

The brake is thus seen to be entirely independent of the trolley current, and therefore its action is not affected by accidents in the power house, sudden opening of circuit breakers, interruption of the line, flying off of the trolley, etc. Unlike the hand brake, the maximum retarding effect occurs at the highest speed, gradually decreasing with the speed. Owing to the high inductance of the braking circuit, the current does not cease flowing immediately the car comes to rest, the brake remaining on an appreciable time afterwards, thus not necessitating ordinarily the application of the hand brake even on heavy grades while taking on a passenger.

Figs. 3 and 4 illustrate the controller which has a single handle to accomplish all of the operations of starting, regulating, stopping, backing and braking. The controller handle is made to operate back and forth over the same contacts for controlling both the application of the current to the motor and braking the car. A self-correcting and interlocking device is also provided, shown at A, A',

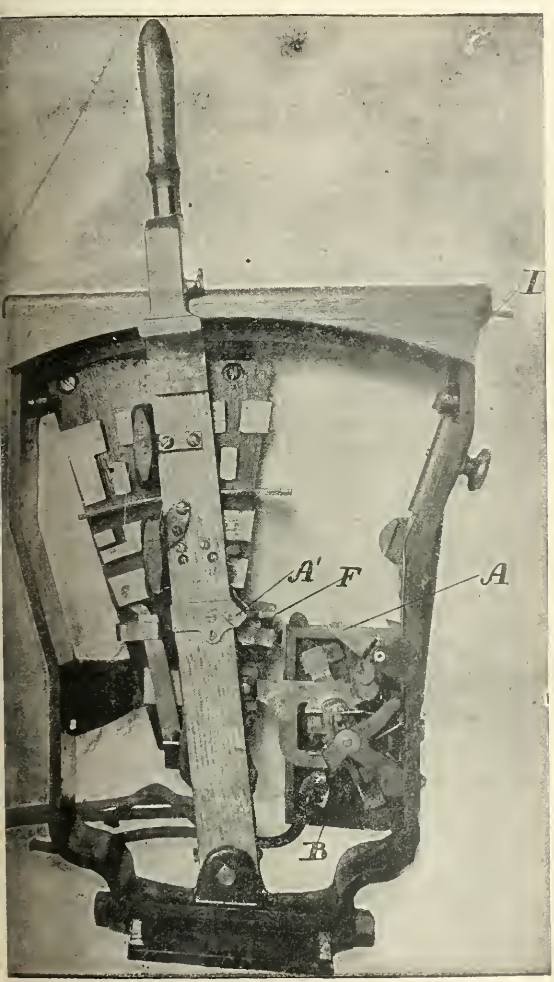
Fig. 3, so if the motorman does not throw the handle clear over, the transformation is completed automatically before the movement of the lever can reach the operating contacts.

It will thus be seen that the brake is automatic and does its work without any special act or even the knowledge of the motorman, who simply works a single handle back and forth. Suppose the motorman wishes to stop his car, he turns off the current by simply swinging the lever over to the right. This operation is made to automatically convert the motor into a special dynamo for generating currents at very low speeds, and also simultaneously to cut

The principal moving parts are simple and durable, being only two in number. An indicator, I, Fig. 3, at the right side of the controller, at the top, shows when the controller is in condition for brake, or is being so used.

The advantages claimed by Mr. Sperry for the electric brake, as compared with former brake systems, its qualities as an accident preventer, as well as its general commercial value, are recapitulated as follows:

1. The certainty of its operation. 2. The enormous power at instant command and under perfect control. 3. The absence of all



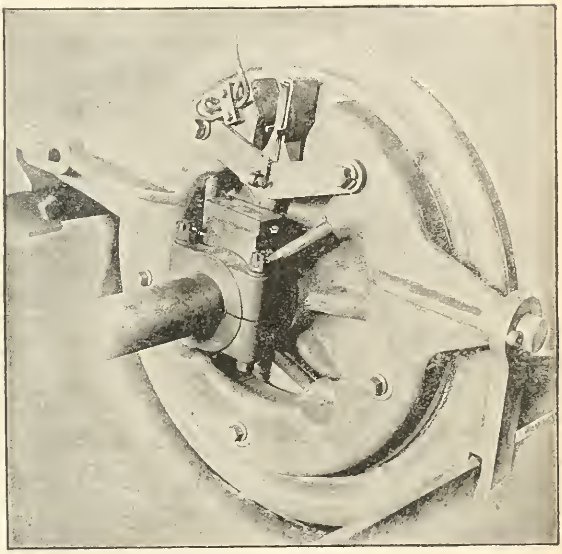


FIG. 2.—BRAKE RING IN POSITION.

FIGS. 3 AND 4.—THE CONTROLLER.

off all connection with the trolley current. The brakes are then applied by simply swinging the handle back over the path it has just traversed; the farther it is swung to the left, the stronger the brakes are applied. The act of releasing or letting off the brakes, again automatically re-establishes connection with the trolley and reconverts the dynamo into a motor. The switches used in part for the conversion of the motor are shown in Figs. 3 and 4, and are under the controller lever at A, the finger F mounted upon the lever forming a part of the alternate stroke operating device. The trolley brake switch B is shown open in Fig. 3. The same rheostat and contact are applied to control the motor while running the car, and also to control the slight amount of current generated by the transformed dynamo to brake the train.

The motorman cannot turn on the current before the brakes have been released, nor apply the brakes before the current is off.

power absorption at moneyed cost from the central station. 4. Its high efficiency, being far superior to compressed air; amply proven in numberless instances where electricity has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power-absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy, not only while compressing, but at other times as well.) 5. Its extreme simplicity. 6. Saving in wheels two to three-fold. 7. Entire saving in brake shoes. 8. Lubrication of brake face; very little wear of either wheel or magnet. 9. Absolute silence of operation and release. 10. The low E. M. F. at which it operates. 11. The ease of its application and control. 12. Conserving strength, and prolonging the usefulness and life of the motormen. 13. The smoothness of its operation. 14. The fact that its use cannot cause flat wheels.

A Study of the Residual Charges of Condensers and Their Dependence Upon Temperature.*

BY FREDERICK BEDELL AND CARL KINSLEY.

When a condenser is subjected to a difference of potential for some time, part of the charge received is absorbed by the dielectric and a part remains upon the surface of the condenser plates. The part absorbed depends directly upon the duration of the time of charge; the part remaining on the surface is practically independent of the length of charge, for the condensers used in the present investigation. This latter part becomes discharged when the terminals of the condenser are connected together through a conducting circuit, and the condenser appears to be in a perfectly neutral condition. The absorbed charge, however, still remains in the condenser and will gradually come to the surface in the form of a residual charge of the same sign as before. If this be discharged, and the condenser be allowed to stand insulated, a second residual charge will collect in the same way as the first. A series of residual charges, with rapidly diminishing values, may thus be formed. Therefore, the condition of the condenser is dependent upon its past charges, some of which may have been held by the dielectric for weeks or even months before appearing upon the surface; a former charge of one sign may entirely neutralize a subsequent charge of opposite sign and smaller value. It has been justly said that the past history of a condenser must be known before it can be trusted.

The object of the present investigation was to determine this soaking-in effect of dielectrics. The condensers used throughout these experiments were furnished by Mr. Stanley in the spring of 1893, and were used in the experiments upon "Hedgehog Transformer and Condensers," described in a paper before the Institute, Oct. 18, 1893.

A study was made, first of the successive residual discharges of a neutral condenser and then of the effects produced by previously charging the condenser in the opposite direction. The absorption by the dielectric was next studied by allowing a charged condenser to stand insulated and discharge through its own dielectric. The effect of a previous negative charge upon this absorption and upon the apparent resistance of the condenser was then studied. An investigation was then made of the influence of initial potential upon the discharge curves, and the insulation resistance, followed by an examination of temperature effects. The influence of temperature changes upon discharge curves through various commercial oils, and upon the resistance of the oils, was ascertained preliminary to similar experiments upon condensers. Finally, the influence of temperature upon the absorption by the dielectric of a condenser was obtained by a study of the successive residual discharges, and by discharge curves at different temperatures.

The several parts of the investigation are separately discussed at length with reference to numerous curves, and the following conclusions are finally arrived at:

The action of a condenser is dependent, in a marked degree, upon its previous history; so much so, in fact, that its previous charges may be of more importance in determining its action under certain circumstances than charges received later. In that case the previous absorption, after neutralizing the absorption due to the final charge, may give rise to residual discharges which increase with time up to their previous initial value.

Absorption gives rise to the phenomena of residual charges and causes the condenser to depart from the exponential law in discharging through its own dielectric. The increase in apparent resistance in the condenser during discharge is associated with this effect of absorption. Previous charges modify these results, increasing or decreasing them according to whether the previous charges were in the same or opposite sense.

The resistance of pure oils is constant at any one temperature, but falls of rapidly with the temperature. There are, accordingly, no absorption or residual effects in pure oils.

In solid dielectrics the effects of absorption are diminished as the temperature is increased, as shown by the residual discharges and by the changes in the insulation resistance.

The authors state that this investigation can in no wise be considered as comprehensive. Many of the results described are already known, but they have not before been presented together so as to show the relation between them. The fact that the previous condition of the condenser has such an influence upon its action, causes considerable embarrassment in an investigation of this sort, inasmuch as a condenser used under certain conditions may be practically useless in the same investigation for further experiments. One of the condensers experimented upon, retained its past charges after being short circuited for a month, and it was necessary to employ another condenser which was neutral, for further experiments.

*Abstract of a paper presented before the American Institute of Electrical Engineers, September 19th, 1894.

Alternating Currents and Fuses.

The August and September number of the *Transactions* of the American Institute of Electrical Engineers contains the paper on "Alternating Currents and Fuses" by Prof. D. C. Jackson and R. J. Oehsner, of which we gave an abstract in our issue of May 26, 1894, accompanied by some remarks in criticism by Dr. Leonard Waldo and Sir David Salomons. It will be remembered that the conclusions of the paper were that, contrary to the statements made by Cockburn, Salomons, Matthews and others, the alternating current does not produce any disintegrating effect in fuses.

Dr. Waldo insists upon the importance of the results of experiments on fuse wires being accompanied by a chemical analysis of the metals used, and that the essential quality of a good fuse wire is that it should be homogeneous. Sir David Salomon adheres to his statement that fuse wire is apt to alter; and in his experiments he found that in no two samples of wire were the alterations the same, which was due chiefly to impurities in the metals tested. From an exhaustive series of experiments made on various metals and alloys at different temperatures and periodically cooled, he finds that they become more or less crystallized after a time, in which his experience agrees with that of others; also, that when the wire is in a crystalline or granulated form a larger current may be passed before the fuse gives way than when the fuse is new. One of the chief reasons why the alternating current appears to alter the fuse wire more than the direct current he believes follows from the variations in E. M. F. in the alternating system being greater than in the direct. He strongly advocates the use of tin wire for fuses, which is not only cheap but has proved very good in practice.

Prof. Jackson replies that the paper criticized was not intended to indicate what would be the best metal for fuses, but was simply an account of a series of careful tests of samples of metals taken directly from the factory. Of course, he says, if the fuse is not homogeneous—if it is made of cast iron or some such metal—the alternating current might possibly rack or crystallize it, but in the commercial fuses tested the results indicated that the effect of alternating currents is not injurious.

Alternating Currents in Direct Current Armatures and the Bad Effects on Machines.

BY G. J. SCOTT.

Having had occasion recently to examine several 80-kw. multipolar dynamos, I noticed that there was a tendency to spark, and for every fifth bar in the commutator to cut away as though the spark was particularly vicious at these points. Thinking that it might be loose connections, I examined closely and found that all connections were good and tightly soldered. I then began to study the matter from a different standpoint, and found that it was due almost entirely to the action of alternating currents, a primary and a secondary.

The primary current was due to the fact that the armature bolts and spiders were not properly insulated, and as the armature is of the Gramme type, running outside of the field poles, and the armature bolts are on the outside of the armature discs, they cut the leakage lines from the armature poles. These poles are established between the field poles, both inside and outside of the armature rings, and the leakage increases with the load. The speed being constant and the field increasing with the load, the tendency is to shift the neutral line out of its normal plane and of itself cause a spark at all the bars. Those coils which are nearest and parallel to the armature bolts, have a secondary induced alternating E. M. F. in them at the time they are short circuited by the brushes. This E. M. F. depends for its value upon the ratio of the length of the armature bolt and the length of the armature conductor exposed to induction. As long as this matter is ignored by the manufacturers of this machine, just so long will it be an impossibility to make the machine sparkless, and make it compound properly on heavy loads, however nice it may operate on light loads with comparatively small armature reaction. This points out the importance of making armatures for large machines very carefully and using every endeavor to insulate the bolts from both the core discs and spider, and, above all things, of preventing, as far as possible, any closed circuits either of iron or brass in or about the armature body, which will either cut, or include and exclude lines of force. There are a number of good mechanical methods of suspending armature bodies from the spiders that are not expensive, and care should be used to

select the one that will satisfy all conditions. Care should be used on the part of the designer of dynamos of any type to apply first principles with good judgment and to seek for bad effects even if he is quite sure none will be found.

Where the ring armature is used, great attention should be paid to the way in which the bolts are put through the armature discs. The section should not be reduced any more at one point, or any oftener in the circumference than can possibly be avoided, as this in itself will cause a variable leakage and a consequent spark at brushes due to a moving neutral plane.

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—Although such questions as the one here discussed cannot be finally decided from theoretical reasons, since we are never certain that all conditions have been taken into account in the theory, still, there are some facts so well-established by practice and experiment that deductions made from them have almost the value of actual tests, and the writer therefore ventures to make the following remarks:

1. The only advantage which has been claimed for the non-sinusoidal curve of voltage is that the hysteresis is reduced, in the case of the first curve shown by the London "Electrician," (Fig. 1) about 10 per cent. This amounts to a saving of about 15 per cent. of the total energy transmitted. This saving only occurs with a peaked curve of voltage, the blunt curves having about the same amount of inferiority to the sine curve. It will be seen that the total amount of saving is insignificant.

2. The disadvantages which both peaked and blunt curves have compared with the sine curve are, first, increased eddy current losses; second, increased inductive drop; third, increased charging current.

The first of these is of little account in many cases, only rising into importance in special cases, so that we may neglect it.

With the second, however, the case is different. If we take the case of the line transmitting 1,000-h. p. a distance of five miles at a voltage of 10,000, we find that, under ordinary conditions of economical line construction, the inductive drop is at least about 30 per cent. of the resistance drop. Roughly, then the impedance factor for the third harmonic will be about 1.9, or, taking the case of the curve mentioned above, the actual number of volts cut off from the third harmonic curve is nearly 25 per cent. of that cut off from the fundamental, though the amplitudes are in the ratio of 1.7.

In regard to the third disadvantage, the charging current in the line will be increased more than 45 per cent. This means more than double the C^2R loss due to this effect, and also an increase of plant. On an overhead line, and with the insulators covered with a film of moisture, this would be a serious matter.

3. The disadvantages peculiar to the peaked form of curve are:

First, the greater cost of the line, or else a greater drop. Since the maximum voltage determines the insulation of the line, and since, if we have a peaked curve and a sine curve transmitting the same amount of power, the maximum voltage of the peaked curve, (in the case considered) will be about 15 per cent. higher than that of the sine curve, it is evident that we can, without having any more insulation on the sine curve line than on the other, increase the voltage on the sine curve about 15 per cent. This enables us to decrease the current about 13 per cent., and so to save no less than 25 per cent. of the C^2R loss in the line, while transmitting the same amount of power as the peaked curve.

Second, the peaked curve is not so efficient for arc lighting. This is probably due to the fact that a certain voltage is required to maintain the arc, and this voltage persists for a shorter time in a peaked curve than in a sine or blunt curve. This was first shown by the German experimenters in the paper referred to by the "Electrician."

The most important disadvantage peculiar to a blunt curve is that it does not give a regularly rotating field when used in two phases. If the maximum point of the third harmonic coincides with the maximum point of the fundamental, the field will rotate fairly evenly, while if the lowest point of the third harmonic, of the same magnitude, coincides with the highest point of the fundamental, the velocity will be irregular. To take an extreme case, a saw-tooth curve will give a fairly regularly rotating field, while a top-hat curve will give a field which moves instantaneously from a point on the field to one 90 degrees away, pauses there through ¼ of a period, and then suddenly moves through another 90 degrees. Under such circumstances, the efficient working of an induction motor is an impossibility.

Summing up we see:

1. That the *peaked curve* has an infinitesimal advantage over the sine curve in the matter of hysteresis.
2. For working induction motors it is nearly as good.
3. That it is very much inferior to it when the cost of the line to carry a given amount of power is taken into consideration.
4. That it is poorer for arc lamps.
5. That the charging current and C^2R loss are very much greater.
6. That the *blunt curve* is better than the sine curve for running arc lamps.
7. That it is very much inferior to it for running induction motors.
8. That it has a much greater charging current and C^2R loss.
9. That, were it not for the greater inductive drop, it would effect a saving in the line cost.
10. Neither the peaked nor the blunt form of curve permits of the use of condensers to neutralize self induction.

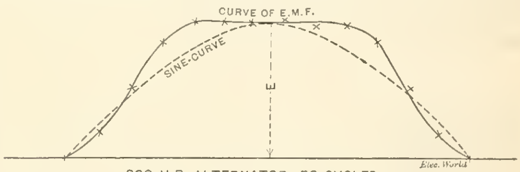
On the whole, it will be seen that the sine curve has the balance of advantages in its favor, and is more generally adaptable than either of the other forms.

With regard to the remarks of M. Blondel, concerning the permanence of the sine form of curve, I would say that if a sine curve is put into the primary of any well designed transformer, a very close approximation to a sine curve will come out of the secondary, except at very light loads, and that in the transformers experimented upon by M. Blondel, the iron must have been worked at a higher induction than is usual, or else the hysteresis losses per cm^3. must have been greater than is usual in good iron.

Pittsburg, Pa. REGINALD A. FESSENDEN.

To the Editor of The Electrical World:

Sir:—In my opinion the form of the curve of alternating E. M. F. has rightly received much attention and a builder of alternators should determine experimently the E. M. F. curve of every type of apparatus constructed. I enclose the



200 H.P. ALTERNATOR—50 CYCLES

CURVE OF OERLIKON ALTERNATOR.

E. M. F. curve of an Oerlikon alternator, the armature coils of which are fastened on iron teeth which become broader toward the toplike the pole pieces of a dynamo. The top of the curve is flattened and for a long distance a straight line. The sine curve having the same amplitude E, is drawn in dotted lines. It is evident at a glance that the E. M. F. curve has a greater mean ordinate than the sine curve, the former being nearly 1.1 as great as the latter. In order to obtain the same mean ordinate for the sine curve the amplitude would have to be about 15 per cent. greater. The work done is, however, propotional to the square root of the mean square of the E. M. F., and the difference is therefore greater than 10 per cent. against the sine curve. The energy of magnetization in transformers will, however, be nearly the same for both curves.

It follows, therefore, as regards the demands of insulation and the work of magnetization in transformers and motors, that the above curve of E. M. F. is preferable to the sine curve. But also in practical use of both single and multiphase motors, it has never been proven that a different form of curve would give better results, although motors built at Oerlikon for 40 to 100 cycles have been supplied to central stations whose generators have been of vastly different construction from those of the Oerlikon works.

According to our experience, therefore, it is altogether unnecessary to attempt to obtain a sine curve. Every designer may rest satisfied if he obtains a curve the mean ordinate of which is at least equal to that of the sine curve of equal amplitude and the rise and fall of which is uniform. In the so-called iron clad alternators, which are becoming more and more popular because of their greater output per unit of weight and their smaller exciting current, a closely approximating sine curve of E. M. F. can never be contained. E. ARNOLD.

Carlsruhe, Germany.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Electricity Considered as a Whirling Movement.—In a French Academy paper by Mr. Zenger, reprinted in "L'Elec." September 8, he describes a number of experiments tending to show that an electric discharge produces a whirling motion of material in the electric field; a discharge through the fumes of the vapors of ammonia and hydrochloric acid shows these whirls; in another experiment two small pieces of tinfoil are pasted on a photographic plate, which was covered with a light brown layer of lamp black; after the discharge between the two pieces of foil a white trace was found, which was larger in the middle, while there was a black line through the middle of it; he believes this demonstrates that electricity causes the molecules to describe a trajectory entirely different from that of light; the effect in the latter can be represented in general by a screw of invariable pitch, traced on the surface of a cylinder, whose base is circular or eliptical, while that of the electric movement can be considered as a screw traced on a conical surface with a variable pitch, the spires of which are enlarged toward the middle of the discharge. Several other similar experiments are described with a silver mirror; also the effect of a bolt of lightning on a mirror.

Capacity of Condensers with Alternating Currents.—An illustrated paper by Dr. Sahulka is published in the "Zeit. feur Elek.," September 1; it appears to be the same as that abstracted in the Digest, January 20, an English abstract of which was referred to March 17.

Resonance and Interference.—Mr. Trowbridge's paper from the "Phil. Mag.," for August, is abstracted briefly in the Lond. "Elec. Rev.," September 7.

MAGNETISM.

Magnetization Curves.—The "Elek. Zeit." September 6, publishes the results of recent tests made by the firm of Krupp in Germany, with dynamo steel, cast iron and Swedish charcoal sheet iron; a set of curves showing the hysteresis loop is published for each and the numerical results are given for the first. A second set of curves for the relation of the permeability and the induction is given in each case, deduced from the hysteresis curve and which "do not represent the permeability, but the quotient of $\mathfrak{B}$ by $\mathfrak{H}$." This second set of curves have a peculiar shape and it is questioned whether such a method of representing the curves is of any practical value, as it is stated that they do not represent the permeability, but that the relation here is similar to that in the methods in which the internal resistance of a battery is measured when the polarization is included as a part of the resistance.

Magnetic Qualities of Asbestos.—The Lond. "Elec.," September 7, states that Mr. Swinton has found that an asbestos mill-board can be lifted by a strong magnet, and that it is possible to magnetize it, thus showing that this material is not suitable for delicate magnetic instruments.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—In the "Elek. Zeit.," September 6, Mr. V. Hefner-Alteneck replies to the article of Messrs. Lummer & Kurlbaum, which was abstracted in the Digest last week, in defence of the adoption of the Hefner amylacetate lamp as a physical standard of light. He does not approve of the distinctions made between the terms "physical" and "technical" standards when applied to his lamp and claims that it is just as much a physical standard as the new platinum standard of Lummer & Kurlbaum; his lamp should not be ranked with the candle, carcel lamp, etc., as these are really only sources of light and not real units; his lamp is a true unit by itself, and should not be used as a secondary standard; when he originally proposed it 10 years ago, it was with the intention that it should be adopted as a unit; although the new platinum standard may admit of a greater accuracy, it is based like others only on an arbitrary system and not on the C. G. S. system, and it requires complicated and delicate apparatus, together with a considerable application of skill in its handling.

Standard Units.—The first portion of an article is published in the Lond. "Elec. Rev.," September 7; it is a brief acknowledgement of the work of the B. A. Committee.

Terms.—The Lond. "Elec.," September 7, editorially suggests that the old term "volt-ampere" might be used to represent the products of the volts and amperes in alternating current circuits in which the lag is neglected, thus distinguishing that product from the true watts.

Indicating a Fault in a Submarine Cable.—In the Lond. "Elec. Rev.," September 7, Mr. Rymer-Jones describes in detail, together with diagrams, a new zero method for determining the position of a fault in a submarine cable between the repairing ship and the shore when the conductor is not broken; it is based on the principle of the fall of potential; the method has been used with success and he believes it to be the first method described in which the test might conveniently be carried out on board ship; the description does not admit of being abstracted.

Harmonic Analyzers.—The Lond. "Elec." September 7, reprints a British Association paper by Prof. Henrici on integrators, harmonic analyzers and integraphs; it is not the same paper which was published in the "Phil. Mag.," for July, although it contains a description of one of the machines mentioned in that paper.

Pocket Galvanometer for Telegraphers.—A simple form of instrument is described and illustrated by Mr. Mixa in the "Zeit. feur Elek.," September 1.

Laboratory in Paris.—The Lond. "Elec. Eng.," September 7, gives a brief description of the history of the Central Electric Laboratory in Paris.

DYNAMOS AND MOTORS.

Self-excited Alternators and Alternate Current Motors.—The "Elek. Zeit.," September 6, contains an article by Mr. Teege on the influence of self-induction on the field excitation of alternating current machines. He calls attention to the desirability of making alternators self-exciting, mentioning some suggestions that have been made and then proceeds to discuss mathematically at some length a method proposed by himself; it consists essentially in generating in the alternator three entirely separate currents, having a phase difference between them of 60°, each of these is then rectified by means of a commutator and each of the three currents then circulates independently and insulated from the others, around the field magnets; there are two advantages, one of which is that the magnetising force will be three times as great, and that the production of sparks will be only very slight; during the time when the first current is commutated the second and third continue; the commutation of one current can therefore only produce a slight change in the number of lines of force, for which reason the commutation will be almost without sparking; the currents for the excitation of the field have no connection with the main external circuit; the application is specially suitable for three-phase generators. He discusses only the theoretical side of the question and considers first the simple case of two currents with 90° phase difference; after an analytical discussion, accompanied by graphical diagrams, he applies the results and shows that the sum of the two currents (about 25.5 amperes) is very nearly constant and that the current at the moment of commutation is only 2.73 amperes, while if there was only one single phase current it would have been 12.6 amperes. To show the small effect of the self-induction he calculates the results for the extreme cases of a self-induction of zero and one of infinity and finds that between these extremes in the self induction the current at the time of commutation varies only between zero and 2.73 amperes, while with a single-phase current the variation would be between zero and 12.73 amperes. Another advantage is that if the magnetic density is 10,000 or more per square centimeter, variation in the current will not produce a very marked effect on a change in the number of lines of force; the coefficient of self-induction will then be far below the value which he assumes. He then considers in the same way three currents of 60° difference in phase, and shows that the sum of the currents (about 38 amperes) has become practically constant and the value of the current at the moment of commutation is now only 1.181 amperes, while for the extreme case of an infinite self-induction it would be only 1.184, showing that the influence of even enormously high self-induction is negligible. He shows that the minimum sparking will take place at an extremely small shifting of the brushes and that in practice it is independent of the self-induction in the winding of the field magnets. For this reason he suggests to build motors similarly to generators, which can be done in two ways; in the first case the generator and motor are exactly alike, having this independent winding on the armature for excitation; if the three-phase current is sent into the main winding of the armature the motor will start, if not loaded too heavily, and will reach a synchronous speed; a three-phase current will be induced and will excite the magnets, after which the motor will run synchronously; in such a motor a greater density in the iron can be used than in three-phase motors, and it is free from the

objections due to the self-induction in ordinary alternate current motors; in the second case the field magnets are excited from the source and the motor is allowed to reach a synchronous speed, after which the magnet windings are connected to the external circuit (the description is not quite clear) which presents no difficulties, as the coils in this arrangement are quite safe and free from self-induction; both kinds of motors can be used also as generators and they are inferior to continuous current motors only in that they will not start when fully loaded. He mentions briefly another application of this method in the rectrification of currents and in the application to charging accumulators by the method of Mr. Pollak, in which the interruption of the current takes place when the counter E. M. F., of the cells and the direct E. M. F., of the line balance each other.

Coupling Alternators in Parallel.—An arrangement deivsed by Mr. Kapp is described by him with the aid of a diagram, in the "Elek. Zeit.," September 6. He states that the parallel running of alternators has become the rule during the past years and that the use of independent machines, each having its own circuit, has shown itself to be too complicated, having the disadvantage that the machines in general run under more unfavorable conditions than with parallel running; practice has shown that all good modern alternators can be coupled in parallel; when difficulties arise they are not due to the alternators, but to the source of power. With the present method of coupling alternators quite a little experience is required and there is often a loss of time in making such connections; to overcome this he designed the arrangement which he describes, and which has been in successful use in the Bristol station. It consists in general in first connecting the machine which is to be coupled, to the circuit through two choking coils in series; the choking coils are so designed that with double the voltage of the machine, somewhat less than the normal machine current will pass through them; when the machine has reached nearly its proper speed current will begin to flow through the choking coils and this current will quietly force the machine to the proper speed; one of the coils is then short circuited, which will increase the current and will force the machine nearly into the same phase; when the second coil is short circuited, there will be another increase in current, which will force it completely into phase, after which the machine is connected directly to the mains. With this apparatus a machine can be coupled, as a rule, in about 20 seconds and requires no other precaution than to close the switches in the proper succession; the choking coils need not be very large, as the current which flows through them is only of very short duration. A somewhat similar apparatus is used by The General Electric Company, in which, instead of short-circuiting the choking coils, a copper cap is moved over the coils to diminish their self-induction

Tests of a Non-synchronous Motor.—The "Elek. Zeit.," September 6 reprints from the Italian, a table of results of a very complete test made by Mr. Arno with a Brown non-synchronous motor (see Digest, Feb 25, 1893) of 15-h. p. The motor starts as a multiphase motor, after which it runs as a non-synchronous single phase motor; it weighs 1,200 pounds and runs at a speed of 800 revolutions at 150 volts and 40 periods; to start it takes 20 seconds, during which time it is running with a loose pulley. A table and several curves are given, from which it appears that the maximum commercial efficiency was 88 per cent. at about 12-h. p. falling from there to 74 per cent. at 6.7-h. p. The results are considered favorable, but it is claimed that it should have been rated only as a 12-h. p.; there is a very rapid falling off in the efficiency at overload, it being 15 per cent. for a 10 per cent. overload; no figures are given for greater overloading unfortunately. (Similar tests of a smaller motor of this kind were abstracted in the Digest January 20).

Dynamos for Electrolysis.—In the "Elek. Zeit.," September 6, Mr. Dahlander gives a brief description of the large 220-h. p. dynamos used in a large installation in Sweden; they run day and night at 115 volts and 12 amperes and are absolutely sparkless; the magnetic field is ex extremely strong and the pole pieces are split in a plane parallel to the lines of force in the field, but perpendicular to those in the armature, in addition to which the Sayers' method (see Digest, June 10-17, July 1), 1893, is employed. The installation is for the production of chlorate salts, according to a newly discovered process, and is an exceptionally large one, containing 8 of these machines, to which 10 more are to be added.

ARC AND INCANDESCENT LIGHTS.

Efficiency of Incandescent Lamps.—An abstract from a forthcoming work by Dr. Fleming is published in the Lond. "Elec.," September 7; it is in the nature of an interesting summary, but contains nothing new. He shows how the luminous efficiency, that is the efficiency of transformation of the electric current into light, can be determined for the incandescent lamp, stating that it varies from 3 to 7 per cent.; reference is made to the experiments of Mr. Merritt of Cornell University. He considers the changes that go on in a lamp during its life, giving curves from a paper of Prof. Nichols of Cornell University. Regarding the so-called "smashing point," he states that it is not always advisable or necessary to replace a lamp when this point has been reached, because if the lamp is giving light enough then, although its candle power is diminished also, the total sum which is being paid by the consumer for the energy is, on the whole, diminished and therefore the lamp is costing the consumer less on the whole to maintain in action, than a new lamp would do if it replaced the old one, although the cost of the lamp per candle light may be considerably increased. He gives two tables containing the candle-power of lamps when used at varying voltages, showing how enormously the light varies with the voltage.

Alternating Current Arc.—The Lond. "Elec.," September 7, reprints from a book recently issued by the Helios Company, some curves showing the distribution of the light from alternating current arc lamps under various conditions. In one case the current for two lamps was the same, but the voltage in one was 28.5, and in the other 32.5; they showed that with an increase of 14 per cent. in the volts and nearly 10 per cent. in the watts, there is a decrease of more than 15 per cent. in the spherical candle-power. Another diagram shows the candle-power with different currents, the voltage being in each case that which was best for the particular current; the voltage increased from 25 to 30 while the current decreased from 50 to 8; it seems from these curves that a 10 ampere lamp is very inefficient when compared with larger ones. A third diagram shows the effect of a reflector of that company, which consists of a white enameled iron disk placed immediately above the arc and just large enough to reflect the rays which would pass upward; two curves are given, one with and one without a reflector; in the former case the spherical candle-power was 275, and in the latter the hemispherical candle-power was 498, the consumption in both cases being 310 watts.

Reflectors and Reflection.—An editorial under this heading in the Lond. "Elec.," September 7, calls attention to the great increase in the amount of light in interior illumination due to the reflecting character of the walls and ceilings; referring to the results obtained by Dr. Sumptner (see Digest, March 4, and The Electrical World, March 18, p. 205) it states that if the walls and ceilings were well whitewashed, for instance, the light in the room would be increased five-fold (presumably over that which it would be if the walls were black or if the lights were in the darkness of the open air. It states that if the business of an electric light engineer is to provide light and not merely to sell dynamos and lamps, it is his duty to attend to the use of reflectors and reflection. It states that for street lighting reflectors are of no use whatsoever in connection with continuous current arcs.

Diffusion of Light.—The translation of a paper by Mr. Wiener from the "Wied. Ann.," vol. 47, p. 638, is published in the Lond. "Elec.," September 7. It is of scientific rather than of practical interest, dealing more particularly with the imitation of brightness in paintings. After giving some historical data he describes some tests made about 10 years ago with light which was diffused and reflected from surfaces of cast plaster of Paris; a number of curves are given showing the quantitative determination of the diffusion at different angles.

TRANSMISSION OF POWER.

Transmission of Power.—A translation of a portion of the article describing the alternate current transmission plant at the Menier farm, abstracted in the Digest, June 9 and 23, is published in the Lond. "Elec. Eng.," September 7, from the Journal of the Institution of Electrical Engineers; tables of data of the motor tests are given.

ELECTRIC RAILWAYS.

Working Expenses of Railways.—The Lond. "Elec. Rev.," September 7, reprints the first part of an article from the "Railway World," in which are given and discussed tabulated data of the expenses reduced to the train and car miles, of the Liverpool, the City and South London, the Birmingham accumulator and the South Staffordshire trolley lines; the results are of interest, but do not admit of being abstracted and some of the conclusions have been published before. The per cent. of expenses to receipts per train mile in the Liverpool line for the year ending last June, was toward the end of that year, 75 per cent.; for the City and South London line it was 79 per cent. in 1891, growing gradually less and being 62 per cent. in June, 1894; for the Birmingham accumulator line the percentage per car mile was low at first, but was slightly over 100 per cent. for the last three years, showing that the road is now being operated at a loss; the results for this line are discouraging; for the South Staffordshire line the percentage is not given. Data regarding cable lines are to follow.

Utilizing the Energy Lost in Braking.—In an article in the "Elek. Zeit.," September 6, Mr. Baumgardt calls attention to the amount of power lost in the brakes of an electric line and calculates the percentage in an assumed case, showing how much of it could be recovered and utilized. The motor must have a magnetic field, the polarity of which is independent of the armature current; he assumes a route with 12 different grades and calculates the energy taken from the line on upgrades and levels and that restored to the line on the down grades, for assumed speeds; in this particular case in which the grades are from a level to 10 per cent, and thence back to a level again, he finds that 31 per cent. of the energy will be saved on a complete trip, if the motor is used as a brake to restore current to the line; in practice this percentage will be somewhat smaller on account of the effect of curves and stoppages. He gives the general expressions for calculating these results and illustrates the deductions by an application.

Electric Traction.—The report of Van Vloten to the Permanent International Street Railway Union, is abstracted briefly in the "Elec. Zeit.," Sept. 6. On Jan. 1, 1894, there existed in the United States 12,029 kilometers of electric railways, with 18,200 cars, while in Europe

the corresponding figures were 309.9 and 706; in Germany there were 102 kilometers. In the United States the total number of kilometers of street railways at that date was 19,326, of which 5,327 were run by horse-power, 1,059 by cable and 911 by steam (a kilometer is equal to .621 mile). He believes that the arguments against the unsightliness of the overhead wires have been exaggerated abroad; he states that in changing a horse-car line into an electric line an increase of 20, 40 and even 80 per cent. in the receipts have been obtained.

Self-motive Carriages.—"La Nature," Aug. 25, contains a description with illustrations, of the prize winners in the recent competition in Paris of carriages that contain their own motive power; none of these were electrical; a brief summary is published in the Lond. "Elec. Rev.," Sept. 7.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Automatic Regulator.—In "L'Elec.," Sept. 8, Mr. Rechniewski describes the Postel-Vinay regulator for keeping the potential at the voltage of the lamps constant and indpendent of the speed of the machine or the loss in the feeders. It consists of a detector which closes one circuit when the voltage is too high and another when too low, these circuits, operating magnetic vibrators which, with a pawl and ratchet, turn the sliding contact of a series of wire resistances in one or the other direction, the resistances being included in the field circuit.

Automatic Controller of Currents.—In an article by Mr. Leroy in "L'Elec.," Sept. 1, he enumerates the objections to fusible and magnetic cutouts, and points out the advantages which a good reliable maximum current cut-out would have, especially in connection with central stations in which a charge is made on the basis of a maximum number of lamps; no description of such an apparatus, however, is given.

Series Incandescent Light System.—A further description of the Goldston system, described in the Digest last week, is published in the Lond. "Elec. Rev.," Sept. 7; the dscription is not very clear.

Refuse Destructors.—In a communication to the Lond. "Elec. Rev.," Sept. 7, Mr. Baker gives some brief statements regarding his system; he states that he fails to see how it is possible that all of the electricity required for the lighting of a town can be generated from the refuse of that town without any expenditure of other fuel.

Train Lighting.—An illustrated description of an accumulator system installed on a number of cars in Germany, is published in the "Elek. Anz.," Sept. 2.

Central Stations Run by Gas Engines.—A brief description of the Reims station, which is said to be one of the most perfect of its kind in France, is described briefly in "L'Elec.," Sept. 8.

WIRES, WIRING AND CONDUITS.

Laws Regarding Electric Conductors.—A report on the proposed French laws by Mr. Berger is published in full in "L'Elec., Sept. 1 and 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Pacific Cable.—Two statements from the London Times regarding the proposals for manufacturers, together with Mr. Sandford Fleming's estimate concerning the capacity, are published in the Lond. "Elec. Rev.," and "Elec.,"Sept. 7, including a short editorial discussion. The Lond. "Elec. Rev.," Aug.31, also contains an article on the Pacific cable.

Telephony.—The article by Mr. Baumann (see Digest, Sept. 15) is continued at some length in the 'Elek. Zeit.," Sept. 6.

ELECTRO CHEMISTRY.

Chlorate of Potash. "L'Elec.," Sept. 1, abstracts an article by Mr. Korda on the electrolytic manufacture of chlorate of potash; he describes the process briefly, the chief advantages of which are that hydraulic power may be used, that only a single material, namely, chloride of potassium, is required, and that there is no residue, while with the chemical process quite a number of materials are required. He mentions an installation in Switzerland which has been running for four years and which is one of the largest factories driven by water-power in Europe.

Large Electrolytic Installation.—The "Elec. Zeit.," Sept. 6, describes the dynamos at a large installation in Sweden in which chlorate salts (chlorate of potash for making matches) are produced by a newly discovered electrolytic method; there are at present 8 dynamos of 220-h. p. in use and 10 more are to be added; water-power is used to drive the dynamos.

MISCELLANEOUS.

Ozone Generator. A new apparatus of Messrs. Bonetti and Seguy is illustrated and described in "L'Elec.," Sept. 8. Discharges from an influence machine take place in a closed receptacle through which the air or oxygen to be ozonized is forced; it is said to be of importance that the two knobs between which the discharge takes place shall have different diameters in order to obtain the maximum effect, the negative knob being the larger one. In the industries the apparatus can be used for numerous applications, for the rectification of alcohols, the artificial ageing of spirits and wines, as also of woods or musical instruments, for bleaching, sterilising, disinfecting, etc.; by using an influence machine the price of the apparatus becomes much less than that of the one ordinarily used.

Blackening of Walls by Conductors.—In a communication to the Lond. "Elec Rev," Sept 7, the recent statement of Nellis is claimed to be incorrect, (the statement was that the blackening occurs when the current is continuous and not when it is alternating); two marked cases are mentioned in which the current was alternating; attention is called to the fact that hot water pipes and incandescent lamps blacken walls and ceilings and it is suggested that the simple explanation of the hot air rising will suffice to explain them all.

Treatment in Case of Accidents.—In a communication to the Lond. "Elec. Rev.," Sept. 7, Mr. Kolle suggests that the Institution of Electrical Engineers should be asked to prepare instructions, dictating the best method of treatment, the instructions being printed on cards of convenient size for handling and posting in prominent places, containing illustrations and a simple, clear, concise statement of the best steps to be taken to restore consciousness; such a card should be placed near every main-switchboard and in each testing room; the suggestion is endorsed editorially.

Lightning.—A French Academy paper by Mr. Berger, published in "L'Elec.," Sept. 8, describes and discusses a lightning discharge of great magnitude noticed recently in Prague; he mentions a photograph, which, however, is not reproduced; there were six distinct bolts which struck four buildings simultaneouly; a curious phenomena shown on the photograph is that the shadow of the cupola of a building was projected on the sky.

Flying Machine.—The "Elek. Tech.," Aug. 31, states that the recent experiments with the Wellner machine proved a failure; it is said to have lifted 350 kilograms with an expenditure of 12-h. p., the weight of the engine being 90 kilograms, and it lacked a force of 540 kilograms to raise itself.

Flywheel Accumulators.—In a reply to the Lond. "Elec.," Aug. 31, Mr. Swinton claims that experience is better than theoretrical consideration and shows that a peripheral speed of 611 ft. per second is obtained in the fly-wheel of the Howel torpedo, 575 ft. in the Laval steam turbine and 590 ft. in the Parsons turbine; he believes it very doubtful whether wheels with hoops shrunk around them or bound with steel wire, would offer any appreciable advantage over a solid steel wheel.

Sealing Bottles Electrically.—According to the Lond. "Elec. Eng.," Aug. 31, a French journal suggests coating the neck and cork of Champagne bottles with copper, nickel or aluminium, so as to close the pores of the cork, making a perfect seal and providing a metallic capsule. 5 per cent of the champagne, as now bottled, is lost by defective corking. The same article suggests the preservation of butter, which, after being covered with plumbago, has a film of copper deposited electrically.

Exhibition of 1900.—"L'Ind. Elec.," Aug. 25, reprints some of the official documents of the coming exhibition, including those concerning the rules, awards, classification, etc.

Prizes.—The subject for which prizes are offered by a French society for the years 1895-96, are given in "L'Ind. Elec.," Aug. 25. A translation of the particulars regarding the prizes offered by a Fernch society are given in the Lond. "Elec. Rev.," Sept. 7.

Biographical.—A sketch of the life of the late Carl Grawinkel, is published in the "Elek. Zeit.," Aug. 23.

New Book.

THE MINERAL INDUSTRY. Its Statistics, Technology and Trade From the Earliest Times to the close of 1893. Statistical Supplement of the Engineering and Mining Journal. Edited by Richard P. Rothwell. New York: The Scientific Publishing Company. 894 pages. Price $5.00.

The second annual volume of this valuable work brings the statistics relating to the mineral industries down to the close of 1893. Those connected with this important branch of our national wealth are to be congratulated upon having such a great mass of statistical, industrial and technical information placed within their reach as is to be found in the 894 large pages of this book. The plan of the work and its thoroughness may be judged from the following contents of the section devoted to copper: The opening portion reviews the copper production during the year 1893, by states and countries, with special references to the output, cost of operating, etc., of the larger mines, and accompanying tables of statistics enable comparisons to be made for a number of years. A special article by A. R. Ledoux discusses "The Future of Copper Production in Montana," and other special articles are on "The American Copper Market in 1893," "The London Copper Market in 1893," "Improvements in the Metallurgy of Copper" by E. D. Peters, Jr., "American Practice in Electrolytic Copper Refining" and "Present Practice in Copper Concentration and Extraction," by Titus Ulke, "Thofehrn's Improved Electrolytic Process," by Hippolyte Fontaine and "The Cupreous Chloride Process," by C. Hoepfner. Other sections in the book of more or less interest to the electrical profession are those on mica, zinc, ozokerite, asbestos and slate. There are also accounts of electrolytic processes employed in reducing various metals.

A Modern System of Block Signals.

Railroad officials, and especially those who have had their positions since the time when a speed of 16 miles an hour was considered a wonderful achievement, have been rather slow to adopt the safety appliances that the modern thought have devised. The tremendous increase of both freight and passenger traffic, together with the high rate of speed at which many of our trains now run, has resulted in the building of two and in some cases four parallel tracks to accommodate the

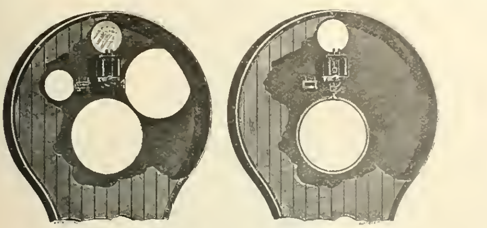


FIG. 1.—INTERIOR OF SIGNAL CASE.

business and reduce the possibility of collisions. While two or four tracks will, in a great measure, insure against the possibility of a head end collision, the colliding of trains running upon the same track in the same direction is in no way eliminated.

Many ingenious devices have been brought out to overcome these dangers, and even after having been practically demonstrated to be valuable adjuncts to any railway, we find that they are seldom adopted by a road until some serious disaster has overtaken it and its treasury drawn upon to indemnify the injured and the relatives of the dead for an amount that would have completely equipped the line with safety signals.

One of the most efficient of such devices is that originated by the Hall Signal Company, of No. 80 Broadway, New York, and a description of its latest system of signals, known as the Hall Automatic, Normal

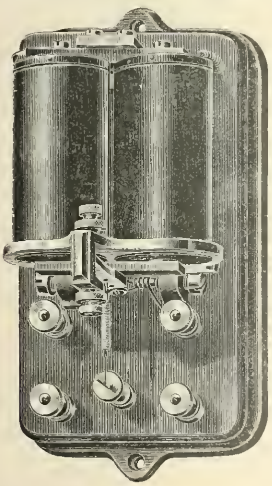
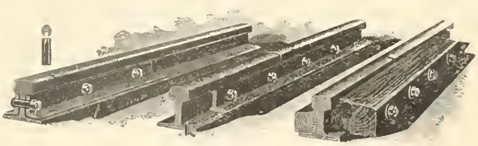


FIG. 2.—THE PERFECTED RELAY.

Danger Track Circuit, Block Signal System, may prove of interest at this time.

On completing the work for the Delaware, Lackawanna & Western Railroad the Hall Signal Company extended an invitation to a number of interested railroad officials to make a tour of inspection. On September 12th a special train consisting of engine, coach and dining car had been placed at their disposal by the railroad company. Among those in the party were the following: Messrs. A. Reasoner, general superintendent D., L. & W. R. R.; W. H. Lewis, superintendent of motive power; William Unroh, civil engineer; Solomon Griffith, superintendent bridges and buildings; F. J. Griffith, division superintendent; P. H. Brangs, chief electrician; James Dalrymple, chief train despatcher; J. Frank Emmon, president Rapid Transit of L. I.; F. S. Gannon, general manager; Mr. Peddle, division superintendent N. J. Central R. R.; William P. Hall, president Hall Signal Company; Melville P. Hall, secretary; C. W. Brewster, sales agent; W. W. Salmon, engineer and Western agent, Chicago. Besides these were a number of newspaper representatives. The trip consumed about four hours, during which time excellent lunch was served, washed down with a liberal supply of "Mumm's Extra Dry."

The distinctive feature of this system is in the use of the rails for conducting the controlling current of electricity. The essential apparatus consists of the signal and relay, shown in Figs. 1 and 2, and the ordinary type of "gravity" battery, from two to eight jars being used upon sections up to two miles in length. In order to diminish the resistance to the passage of the current, the rail joints are bounded by wire and plug as shown in Fig. 4, while the block circuits are electrically insulated from each other by wooden splice bars and fibre and posts or by fibre placed between the angle bar and rail, with fibre end posts and bushings as shown in Figs. 3 and 5. The wooden bar, although not so rigid, is preferable to the fibre as it lasts much longer and is less expensive to install and maintain. For making and breaking either the



FIGS. 3, 4 AND 5.—RAIL JOINTS AND CIRCUITS.

controlling or operating circuits the relay above referred to is used. By reason of the many improvements in the design and construction of this instrument, the perfected relay and its related parts being shown in Fig. 2, it is now possible for the Hall Signal Company to successfully operate under any track conditions which may be met within actual practice. This apparatus has shown itself to be perfectly reliable under extremely unfavorable conditions of weather, ballast, length of section, etc., without appreciable variation from its operation under favorable conditions.

In the system, as installed upon the D., L. & W. R. R., the signals stand normally at danger and are cleared by an approaching train upon entering the preceding block. The signal is again put to danger when the train reaches a point directly opposite the signal it has cleared.

The signal circuit cannot again be restored until the last car has left the section of the track in the block. Let us suppose that our train has reached a point within a block known as No. 10, and that another train is following and has arrived in No. 9, the preceding block. With

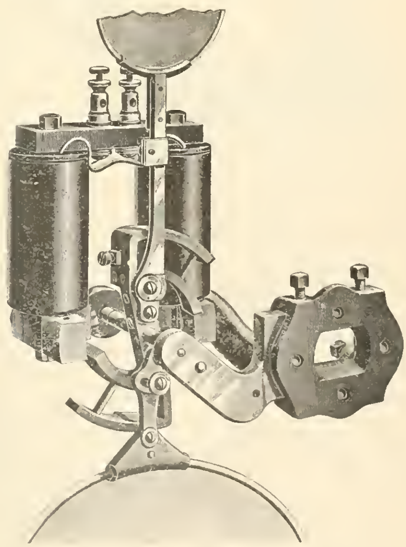


FIG. 8.—THE SIGNAL MECHANISM IN DETAIL.

a clear track in block 10, the signal at the entrance of block 10 would be drawn from "Danger" to "Clear," but this circuit being controlled by the train within the block, no current can pass and the signal remains at danger. This would also be the condition of the signal if its circuit became disarranged, and it is this feature that makes the system so eminently successful, the "clear track," or "Safe Signal" being dependent upon the flow of the electric current, while the "Danger Signal" is dependent only upon gravity, which is always the same regardless of place or weather conditions.

In Fig. 1 is shown the interior of the signal case, the left hand por-

tion showing the "Danger" position of the signal, which is, as above stated, dependent upon gravity, and at the right hand, the signal is at "Clear," which is dependent upon electro-magnetism.

Fig. 6 shows the mechanism in detail, consisting of two magnets and revolving armature, to which is connected the arms carrying the red discs, the lower one being for the day and the upper one for the night signal. A sectional view of the switch instrument is shown in Fig. 7. Normally, the contact point of the spring is closed and to open the switch is the equivalent of placing a train upon the track at that point. Another feature of this system is the fact that the battery is in use only a small portion of the time, thus rendering it the cheapest system to maintain. In the location of automatic signals the prime consideration is to so space the several blocks that the heaviest traffic likely to be had on the blocked track may be handled without interruption on account of the block being too long. In order to do this a thorough investigation is made into the condition of train service, alignment, grades, switching points, stations, water tanks, etc. After securing this information the signals are so located that, with unequal space intervals, the time ordinarily required to pass through the several blocks will be fairly equal. Thus, at stations, where a train generally stops, or on heavy up grades, blocks should be shorter than on the open road or down grades.

Signals are also located sufficiently far in advance to give an engineer ample time to stop after seeing the signal at "Danger."

As to the efficiency of this apparatus it may be well to quote from the 23d annual report of the Railroad and Warehouse Commission of Illinois. "The importance of safety devices for the protection of trains against collisions was very forcibly impressed upon us by our examination of one of the block signal systems in operation in the State. On the 7th day of September we accepted an invitation from Mr. J. F. Wallace, Chief Engineer of the Illinois Central, to inspect the actual workings of the Hall signal system in use by that company from their depot

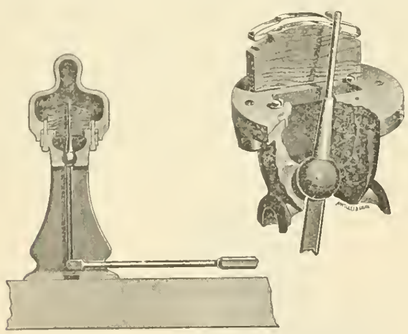


FIG. 7.—SECTION VIEW OF SWITCH APPARATUS.

at Twelfth street to Kensington, a distance of about 16 miles, known as the terminal district of the Illinois Central. The examination was made during the very heaviest of the World's Fair traffic, and we deem it proper to say that in our general examination of the automatic and manual block signal systems for preventing accidents and protecting life and property on railroads, it is our opinion that the Hall system is among the best. One of the very important adjuncts of this excellent device is that while it apparently covers all the conditions of safety, its reasonable cost of installation and maintenance brings it within easy reach of many of the railroads, and reference to the report of our consulting engineers, found in this volume, will show the roads which have adopted block systems and the number of miles of each road protected by them.

"We are informed by the management of the Illinois Central that not a single accident occurred on that part of their line protected by the block signals, during their World's Fair traffic, which could in any way be attributed to defects in the block system; the average number of daily trains handled was between 700 and 800, and the number of passengers carried during the period of the Fair was 9,600,000, exclusive of through passenger business. This, in our mind, is proof conclusive that the block system in use on the road is a success."

The total number of passengers carried by the Illinois Central Railroad in the terminal district under protection of the Hall system was over 19,000,000 in the six months during the Fair.

Bug-proof Electric Bell.

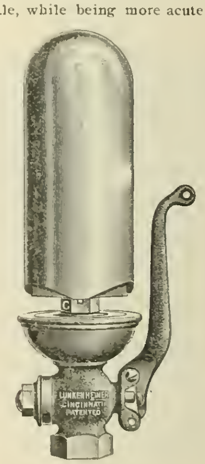
The electric bell we illustrate, manufactured under the Varley patents, and which the Central Electric Company, 173 Adams street, Chicago, makes one of its specialties, ingeniously provides for a serious defect in ordinary bells from the destruction of contacts by bugs. In the Varley bell this vulnerable point has been ingeniously protected by a small elastic covering that completely encloses the solid platinum contacts, but does not in the least restrict the free vibration of the clapper. The bell being, otherwise, of the open frame construction, there are no inviting nooks where bugs will gather. The magnets are duplex wound and so arranged that the armature gets the full benefit of the "pull," and

IMPROVED BELL.

can be operated with much less battery than needed with an ordinary bell.

Single Bell Chime Whistle.

The style of single bell chime whistle, manufactured by the Lunkenheimer Company of Cincinnati, Ohio, which we illustrate, is handsome in appearance and produces harmoniously three distinct tones, which blend and form an agreeable musical chord. The sounds given forth from this chime whistle, while being more acute and piercing than the



CHIME WHISTLE.

common whistle, have not the harsh and disagreeable qualities of the latter and can be heard at a greater distance. Another advantage of this style of construction is that the bell may be raised or lowered to suit varying pressures. To adjust the bell, the jam-nut C is loosened and the bell screwed up or down, until the whistle blows as desired.

The Electrician's Paradise.

According to the London "Electrician," the only European in Korea not paid by the Customs, who gets his pay regularly, is the electrician at the Palace. The King and all at his Court are so afraid of ghosts that they stay up all night. There are sorcerers—and the electric light also—to keep off the ghosts; if the electrician's pay falls into arrears the electric light apparatus breaks down and cannot be repaired until he is paid up.

Telegraphy in the United States.

According to some statistics recently published in a European journal it appears that there are more miles of telegraph lines in America than in all the rest of the world, and that there are a few thousand more miles in the United States alone than in the whole of Europe.

Financial Intelligence.

The Electrical Stock Market.

New York, September 22, 1894.

GENERAL ELECTRIC'S quotations express the present state of affairs emphatically. The people who have been trying to create some sort of public interest in the stock have given up the task for the present and have left the stock to take care of itself, until the value ot the stock will appreciate naturally by reason of the increased business it is now doing. As a result of this neglect by both professional traders and investors, there is an utter dearth of news regarding the General Electric Company's affairs. It is known that a big business is being done, but no definite news of new contracts or new plans of administration are announced. Nor does one hear anything relative to the oft-discussed plan for readjusting the company's capital so as to make it agree with the diminished value of its assets. The committee in charge of the matter has held no meeting of late; one of its members, however, says now that the summer dullness is past, that steps will soon be taken to remedy the company's trouble. There is some justification for the report that the committee has during all the months since April, when it was authorized to devise some plan to make good the impairment of capital, purposely delayed action on the matter for the reason that they were then confident of the early return of better times, when the assets must greatly appreciate.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has declared its quarterly dividend of 1¾ per cent. on the preferred stock, payable on October 1 next, but has again disappointed common stock holders by letting the occasion for declaring a dividend on their stock again slip without letting them participate in the distribution of profits. The management admits that a dividend—and even more than the amount necessary was acquired—was earned on the common stock, but it is still adhering to the policy announced this summer of withholding any share of the profits from common stockholders, till it had provided for all the many improvements it has on hand and in contemplation, when the acquisition of big profits for distribution among the patient holders of the company's common stock will be an easy matter. The company is anxiously waiting, however, to get into the new works at Brinton, near Pittsburg, where the new machinery now being set up will turn out contracts on the most economical basis possible. It was thought that everything would have been ready by now, but the labor troubles of the summer delayed matters, and it will be some weeks yet ere everything is in readiness for removal. As it is, the main building of the new Brinton works is now finished. It was used recently as a convention hall during the encampment of the Grand Army of the Republic at Pittsburg. Its size made it particularly available for the purpose in question. The building is 750 by 410 feet, and, as it is to be chock-full of machinery, it is easily understood why it will take some time to fill this mammoth building with all the machinery that can be set up therein.

FORT WAYNE ELECTRIC—The old stock is slightly higher. The new Fort Wayne corporation is out with a circular urging the shareholders of the old Electric Company to serve their own interests by depositing by October 1 their stock under the plan announced some two months ago. In explaining the new bond issue to be made under the plan, the management of the Fort Wayne Electric Corporation announce that they will be offered at 90, payable 10 per cent. in cash on subscription on or before October 1; 40 per cent. in cash on or before October 31, and 50 per cent. on or before November 20, either in cash or in Fort Wayne Electric Company's stock at $5, or in both stock and cash. It is not announced whether the sucess of the bond issue is guaranteed by an underwriting syndicate.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, has declared its regular quarterly dividend of 1½ per cent., payable November 1, to stockholders of record on October 18. The stock has been rather strong since the publication of the good earnings noted in these columns last week, while there has been a noticeable investment inquiry after the bonds.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2⅞	3
General Electric	100	38½	38¾
General Electric pref	—	70	72
Interior Conduit & Ins. Co.	100	35	45
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	34	35
* " " pref	50	51	52⅛

BONDS.

	Par.	Bid.	Asked.
*Edison Electric Ill., New York	1,000	107⅛	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	203	204
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
Central & South American Telegraph	100	105	110
*Commercial Cables	100	125	145
Erie Telephone	—	50	50⅝
Gold & Stock Telegraph	100	100	103
Mexican Telegraph	100	185	200
New England Telephone	—	68	69
*Western Union Telegraph	100	89⅛	89½

* Ex-div.

AMERICAN BELL TELEPHONE matters promise interesting developments at an early date. Ever since the failure of the company's endeavor in Massachusetts to issue $30,000,000 new capital stock in any way but at public auction, there has been no lack of rumors that the company would remove its headquarters to either New York or New Jersy, where more freedom was allowed corporations. A great deal of importance, therefore, is attached to the fact that there was incorporated at Albany this week the "Standard Telegraph and Telephone Company," with a nominal capital of $50,000, to "buy, lease or operate telephone systems." In the first place the list of incorporators and promoters contains many names of gentlemen interested more or less in the Erie and other companies subordinate to the Bell Company. Then the capital can, under the charter, be enlarged to any extent, as occasion shall suggest. Again, in speaking of the new company's plans, a director says that the Bell patents will be used under arrangements with the parent company. Putting all this together, it is openly asserted by many people that this is the first move preparatory to a change in headquarters. That the new Standard Company, with its unlimited potential capital, will build the lines to the west that the Bell Company proposed with its $30,000,000 new capital, and that the two companies will be so closely identified as to form practically one corporation. In fact, an actual consolidation, with offices in New York City, is declared to be one of the main features of the scheme. The directors of the new company are: Abner C. Adams, Charles J. Glidden, Francis Jewett, James H. Mills, J. W. C. Pickering and Asa C. Russell, of Lowell, Mass.; A. Page Smith and Arthur L. Andrews, of Albany, N. Y.; Jesse N. Truee, of Tewkesbury, Mass.; Charles P. Cummings and Wesley A. Gore, of Boston, Mass.

New Incorporations.

THE NATIONAL ELECTRO-CHEMICAL REDUCTION COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated by W. R. Omohundro, G. E. Plumb and C. E. Ridpath.

THE BALTIMORE, MIDDLE RIVER AND SPARROWS POINT ELECTRIC RAILWAY COMPANY, Baltimore, Md., capital stock $400,000, has been incorporated James Young may be addressed for information.

THE TERRE HAUTE AND BRAZIL ELECTRIC RAILWAY COMPANY, Brazil, Ind., capital stock $100,000, has been formed to construct a line 12½ miles in length. The incorporators are W. H. White, J. G. Elder and others.

THE BLUFF CITY ELECTRIC RAILWAY COMPANY, Waukegan, Ill., capital stock $200,000, has been formed to construct an electric railway in South Waukegan. The incorporators are S. D. Talcott, D. L. Jones, and others.

THE SOUTHERN HARRISON TELEPHONE COMPANY, Alexandria, Va., capital stock $100,000, has been incorporated, with S. W. Tulloh as president, W. H. B. Stout, vice-president, and S. H. Merrill as secretary and treasurer.

THE INTERSTATE TELEPHONE COMPANY, Louisville, Ky., capital stock $2,000, has been formed to operate telegraph and telphone lines, and electric light and power plants. T. G. H. Vance, G. L. Hogan and F. A. Vance are interested.

THE AMERICAN ELECTRIC EXERCISING MACHINE COMPANY, Chicago, Ill., capital stock $50,000, has been formed to manufacture and sell electric exercising machines. Jas. W. Williams, H. J. Weld and W. R. Bullion are the incorporators.

HILLSBORO LIGHT AND FUEL COMPANY, Hillsboro, O., capital stock $20,000, has been formed to manufacture and furnish electricity and gas, for light power, etc. J. R. Cook, E. W. Boxby, H. H. Campbell, Charles Horn and C. H. Moore are interested.

THE HIGHLAND PARK AND BUTLER STREET RAILWAY COMPANY, Pittsburgh, Pa., capital stock $12,000, has been formed to erect and maintain an electric railway. H. S. Stewart, J. J. Donnell and J. G. Holmes, all of Pittsburgh, are interested.

THE NORTHWEST GAS AND ELECTRIC COMPANY, Washington, Ia., capital stock $250,000, has been formed to own and operate gas works. A. E. Johnson, Liberty, Ind., G.W. Benedict, A.W. Snyder and S. C. Green, Washington, Pa., are interested.

THE PATERSON ELECTRIC CONDUIT RAILWAY CONSTRUCTION COMPANY, Milwaukee, Wis., capital stock $500,000, has been formed to manage and operate a conduit system for street and other railways, mills, etc. A. E. Smith, W. Meyst and H. S. Esch are the incorporators.

THE SCRANTON ELECTRIC CONSTRUCTION COMPANY, Scranton, Pa., capital stock $15,000, has been formed to build electric and other plants for electric lighting or power purposes, drilling, pumping, etc. The promoters are F. J. Platt, F. K. Platt and E. B. Sturges, Scranton, Pa.

THE NORTHERN ELECTRIC PASSENGER RAILWAY COMPANY, Harrisburg, Pa., capital stock $100,000, has been formed. The incorporators are A. C. Milliken, Pottsville' Charles H. Davis, S. S. Evans, G. L. Martin, N. A. Waldron, Philadelphia, and W. P. Perry, Langhorne.

THE KERLIN BROTHERS COMPANY, Toledo, O., capital stock $10,000, has been formed to contract for, build, construct and operate electric light and railway plants, gas plants, water works, etc. Richard Kerlin, E. M. Kerlin, W. A. Gashe, M. P. Murphy and P. Henahan are the promoters.

THE SIGNAL AND CONTROL COMPANY, New York, maximum capital stock $1,000,000, has been incorporated to manufacture and sell mechanical, electical and other apparatus. The promoters are N. Seymour, New York, H B. Seymour, Flatbush, and J. H. De Revisse, Brooklyn, N. Y.

THE NEWCASTLE, MINERSVILLE AND TREMONT STREET RAILWAY COMPANY, Carlisle, Pa., capital stock $100,000, has been formed to construct, mainain and operate an electric railway. E. Davis, Broad Mountain, L. S. Sadler, and W. D. Sadler, Jr., of Carlisle, Pa., are the promoters.

THE EUCLID HEIGHTS COMPANY, Cleveland, O., capital stock $500,000, has been formed to construct and operate electric plants, electric and other railways, and also to build waterworks, etc. Pat Calhoun, R. R. Conklin, Wm. L. Rice, George A. Laughlin and A. J. Thompson are interested parties.

THE ROCKWELL CONSTRUCTION COMPANY, Paterson, N. J., capital stock $30,000, has been formed to build and repair electric works, railroads, etc. E. G. Wightman, Middletown, N. Y.,; M. J. Wightman, B. H. Throop and W. B. Rockwell, Scranton, Pa., and J. C. Hinchcliffe, Paterson, N. J., are the organizers.

THE SCRANTON ELECTRIC CONSTRUCTION COMPANY has been incorporated with a capital of $15,000. Mr. Wm. T. Smith is president and Mr. F. J. Platt is the general manager. The objects of the company are to erect plants for the manufacture of lighting, drilling, hauling and mining machinery for the mines.

THE NEW JERSEY ELECTRIC RAILWAY COMPANY, Paterson, N. J., capital stock $2,000,000, has been formed to construct and operate a street railway. C. A. Johnson, Brooklyn, N. Y; G. V. Turner, New York; F. Irving, Jersey City, and J. McGuinness, Jr., Ridgewood, N. J., are among the interested parties

THE ELECTRIC SWITCH AND TROLLEY COMPANY, Newark, N. J., capital stock $500,000, has been formed to manufacture and sell electric and other switches, motors, cars and other improvements and appliances for railways. Emile Rieser, J. S. Campbell, New York, and G. W. Littell, Cranford, N. J., are interested.

THE LOS ANGELES GAS AND ELECTRIC MANUFACTURING COMPANY, Los Angeles, Cal., capital stock $50,000, has been formed to manufacture and deal in electrical fixtures, brass and iron ornamental work, etc. Those interested are M Meyberg, Moritz Meyberg, S. Nordlinger, L. Uhfalder, L. Himmelstern, Los Angeles.

PORT CHESTER RYE AND MAMARONECK ELECTRIC RAILWAY, COMPANY, Port Chester, N. Y., capital stock $150,000, has been formed to build and operate a surface road nine miles long. W. Ryan, H. M. Henderson, N. J. Sands, J. F. Mills, J. M. Sullivan, Port Chester; C. D. Haines, T. F. Woodworth, Port Chester, N. Y., are the incorporators.

THE NEW LONDON ELECTRIC LIGHT COMPANY, New London, Conn., capital stock $4,000, has been formed to generate and furnish electric light, power and heat. D. J. C. Arnold, H. G. Skinners, C. E. Reynolds, S. L. McCready, O. G. Carter, Jr., E. R. Stilson, J. H. Beattie, F. R. Hubbard, W. R. Brundage, R. B. Powers and J. T. Kelley are interested.

THE ZENITH GAS ENGINE AND POWER COMPANY, San Francisco, Cal. capital stock $1,000,000, has been formed to manufacture and sell electric, gas and vapor engines; to build and operate telegraph and telephone lines, also railways, plants, etc. The promoters are John W. Eisenhuth, L. F. Dunand, R. Herman, A. R. Herman and Sam F. Simrah, San Francisco, Cal.

THE CENTRAL OHIO ELECTRIC RAILWAY COMPANY, Mt. Vernon, O., capital stock $100,000, has been formed to construct and operate an electric railway between Pittsburg, Pa., and Chicago, Ill., and also to supply light, heat and power, to construct telephone and telegraph lines, etc. The promoters are G. A. Jones, F. W. Jones, J. A. Caldwell, Wm. M. Koons and M. Spellacy.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Sept. 24, 1894.

MR. EUGENE H. ABADIE, of the Wagner Electric Manufacturing Company, St. Louis, has been making quite an extended trip through the Eastern cities, and when in New York a few days ago called at the office of The Electrical World.

MR. THOMAS C. PERKINS, of the Mather Electric Company, of Manchester, Conn., made a flying trip to New York last week. Mr. Perkins finds business very brisk, the Mather Company having enough orders on hand to keep it busy for the next three months.

A CORRECTION.—In a note in this department in our issue of last week, Mr. Henry B. Oakman, by a printer's error, was stated to be general Eastern sales agent of the Western Electric Company, instead of the Wenstrom Electric Company.

PETER B. SWEENY, a former member of the Tweed regime, has an article occupying all of the first, and part of the second, page of the New York Sun of September 24, attacking the recent New York Rapid Transit Act. It is argued that the act is unconstitutional, and the adoption is advocated of a system of rapid transit provided for by a former legislative grant, which places the necessary power in the hands of the Governor, Mayor and Commissioner of Public Works.

WARREN & LOZIER, mechanical and electrical engineers, 465 Greenwich street, New York, have succeeded to the business of the New York Electrical Repair Company. Enlarged premises and equipment, together with a carefully selected force, enable them to undertake repairs of all kinds, both electrical and mechanical, to electrical machinery, the building of standard, special and experimental electrical apparatus, the erection of generators, motors and engines, and the construction of switchboards of all kinds. Dynamo and motor supplies of every variety will be kept in stock.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
September 22, 1894.

CIFFORD L. SNOWDEN, for the past three years assistant editor of the "Street Railway Review," has resigned to prosecute post graduate work.

THE ROYAL ELECTRIC COMPANY, the well-known Peoria, Ill., firm, is enjoying a season of unusual prosperity, as its apparatus is meeting with much favor wherever introduced.

THE DIAMOND ELECTRIC COMPANY, of Peoria, Ill., will shortly place on the market a new watt meter that promises to be a very good thing. They are now busy manufacturing transformers, on which their enviable reputation was founded.

D. FRED SWEET, inventor of the Sweet limit switch now being manufactured in Grand Rapids, Mich., was a Chicago visitor during the week. Mr. Sweet has a new and greatly improved switch that he is about ready to offer the electrical public.

THE JENNEY ELECTRIC MOTOR COMPANY, of Indianapolis, Ind., has closed an order with the W. S. Tyler Wire Works, of Cleveland, for 60 one-third-h. p. special motors, to be directly connected to wire looms. This is an important order, marking, as it does, a decided advance in the introduction of electric motors in manufacturing establishments. The competition was very warm, but the Jenney motor seemed to get there.

CANADIAN NOTES.

OTTAWA, Sept. 20, 1894.

WINNIPEG.—The electric street railway is to be extended to Armstrong Point.

HULL, QUE.—From appearances the inauguration of an electric light system in Hull will take place at an early date. The matter is now assuming a definite shape.

MONTREAL.—The Holmes Electric Protection Company for Canada has issued bonds in the amount of $75,000, bearing interest at 5 per cent. per annum, having twenty years to run.

TORONTO.—The City Treasurer has received a check for $7,013, being 8 per cent. of the street railway earnings of $87,660 for the month of August. Last year in August the earnings were $89,436, the excess of last year over this being attributed to the military tournament during August.

TORONTO.—Application for a charter has been made to the Ontario government by the Electric Chronometer Company, for the purpose of manufacturing chronometers and other time indicators, supplying by electric means correct time from central clocks, etc. The capital stock to be $100,000.

NEW WESTMINSTER, B. C.—Notice is given that the Westminster Vancouver Tramway Company is for sale, and that tenders will be received up to November 24. The lines extend throughout the city of New Westminster, in the province of British Columbia, and between that city and the city of Vancouver.

HAMILTON, ONT.—The Cataract Power Company, with a capital stock of $100,000, is applying for a charter for the purpose of carrying on a business of an Electric Power Company in all its branches. The operations of the company are to be carried on in the city of Hamilton and the town of Niagara Falls.

OTTAWA.—A charter has been granted incorporating the Packard Electric Company, with a capital of $300,000. The directors are: William Packard and James Packard, of Warren, Ohio, electricians; John Howry and Henry Howry, of Saginaw, Mich., lumbermen; Charles Paige, of Montreal, business manager; Frederick Cavanagh, electrician; Alexander Mackenzie, of Toronto, barrister; and Thomas C. Sims, of Little Current, Ont.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, September 15, 1884.

AN EXHIBITION OF ELECTRIC MOTORS.—The exhibition of electrically driven machine tools, which was announced some time ago to be held at Budapest, has resulted in the getting together of 32 alternate current and 42 continuous current motors, driving drills, lathes, printing presses, ventilating fans, saws, sewing machines, etc.

THE ELECTRIC CONSTRUCTION COMPANY.—This concern, which is one of the first three leading manufacturing companies, and which was founded by Mr. Thomas Parker, who was responsible for the electrical equipment of the Liverpool Overhead Railway, has apparently, under the auspices of Mr. Emile Garcke, who saved the Brush Company from wreck some years ago, commenced an era of retrenchment and reform. As I have already stated, there has been a wholesale reduction of staff, the reduction including Mr. Parker himself, and now instead of as heretofore paying dividends, about the earnings of which doubt existed, the company has devoted what profit it has been able to make to the reduction of its liabilities.

SAYER'S ARMATURE.—The largest dynamos yet built on the principle enunciated by Mr. Sayers before the Institution of Electrical Engineers last summer, is one of 80-kilowatt output, which has just been completed for a Russian factory. Mr. Sayer's device consists in nterposing between each main armature coil and its appropriate commutator section a small auxiliary coil, which he carries backwards along the armature relatively to the main coil connected with it, so that when the main coil is passing under the brush its auxiliary coil is actively cutting lines of force and generating sufficient E. M. F. to enable the current in the main coil, just passing under the brush, to reverse sparklessly. The subsidiary advantage of this device is that it enables the series coils to be dispensed with, since the demagnetising coils usually existing on armatures are no longer existant when Mr. Sayers' device is applied to it, since the brushes need have no lead. At the time this device was described, there was a general consensus of opinion that it marked a most important advance in dynamo design.

News of the Week.

TELEGRAPH AND TELEPHONE.

DURHAM, N C.—L A. Carr and E. G. Linebury are reported to be constructing telephone line and exchange.

THE CITIZENS' TELEPHONE COMPANY, Raleigh, N. C., has been incorporated by A. R D. Johnson and others.

CALVERT, TEX —S. S. Mayo and J. D. Atkinson representing a Chicago company, have closed a contract to establised a telephone exchange in Calvert.

CLINTON, IOWA.—A new telephone company has been organized, which, to start with will have 300 guaranteed subscribers signed for five years. The following are the officers: P. S. Towle, president; A. Lamb, secretary and treas-

urer. No system has been adopted, but the officials would like to hear from all telephone makers.

MASON, O.—The Warren County Telephone Company, Ohio, M. Blake, R. M. Van Herlingen, W. N. Cox, Wikoff and J. M. Van Dyke, propose to erect and operate a telephone line between the Indiana state line and the eastern line of Greene and Clinton counties and through the eastern counties of Warren, Butler, Montgomery, Hamilton, Greene, Clermont and Clinton.

CINCINNATI, O.—The Board of Administration has granted to the Western Union Telegraph Company a franchise for laying conduits for its wires throughout the city. It will require 700 miles of lines to complete the new service.

ALEXANDRIA, VA.—A charter has been granted by Judge Keith of the Circuit Court to the Southern Harrison Telephone Company, to do general telephone business in Virginia and other Southern States. Capital stock $100,000. W. H. S. W. Tolloh, President; W. H. B. Stout, vice-president; S. H. Merrill, secretary and treasurer, and Warren Choate, general manager.

TELEPHONE COMPANIES.—The most complete list of telephone companies in America is given in the new edition, just issued, of Johnston's Electrical and Street Railway Directory, an announcement of which appears in another column. This list includes not only all the local companies operating under the Americn Ball patent, but also companies that have recently been established to introduce other 'phones.

ELECTRIC LIGHT AND POWER.

FREDONIA, N. Y.—The town of Fredonia will be lighted by electricity.

HEMPSTEAD, N. Y.—Address the Town Clerk regarding the contract for electric lights.

BALLARD, WASH.—The town has voted to issue $6,600 in bonds for an electric light plant.

CUTHBERT, GA.—An electric light plant is to be established at Cuthbert at a cost of $50,000.

UNION CITY, MICH.—The citizens voted September 11 to issue $25,000 water and light bonds.

FLORENCE, ALA.—The Cherry Cotton Mills are about to install an isolated incandescent plant.

LUDLOW, KY.—The Council ordered bids to be received September 27 for lighting the city by electricity.

TOLEDO, O.—An ordinance has been passed to improve Warren and Bancroft streets by electric lighting.

STEPHENVILLE, TENN.—Address the city clerk concerning a new electric light plant to be established by the city.

BRIGHTWOOD, IND.—The Brightwood Commercial Club is discussing means of establishing a municipal lighting plant.

DUNELLEN, N. Y.—A meeting of the residents is announced to organize an electric light and water supply company.

GREENVILLE, TEXAS.—The capacity of the Greenville electric light plant, which is owned by the city, is to be doubled.

ALEXANDRIA, VA.—The Court has confirmed the sale of the Potomac Electric Light Company's proprety to A. H. Wiley.

SPRINGFIELD, MO.—The City Clerk was instructed to again advertise for bids for city lighting, to be opened October 15.

COLUMBIANA, O.—The proposition to bond the town for $8,000 for an electric light plant was carried with practically no opposition.

STILLWATER, MINN.—Address J. F. Burke, city clerk, concerning furnshing the city with 15 arc lights and 263 incandescent lights.

TOLEDO, O.—The city electrician and solicitor have prepared plans and specifications and will soon advertise for bids for city lighting.

TREMONT, PA.—The Electric Light & Power Company has purchased the Heil property on Crescent street and will erect its power-house there.

VICKSBURG, MISS.—The proposition for the city to build and run the electric light service as a part of the city is meeting with almost universal favor.

ATTLEBORO, MASS.—At a special town meeting held it was voted to appropriate $4,875 for lighting the streets, the new power-house to furnish the power.

PONTIAC, MICH.—The City Council has awarded the contract for lighting the city for five years to the Commercial Electric Lighting Company, of Detroit, at $60 for each 2,000-c. p.

RIVERSIDE, O.—An election will be held October 15 to vote on the question of issuing $50,000 in bonds for electric light and water works. Roger Wright is Mayor.

OMAHA, NEB.—At a meeting of the Council an ordinance to submit a proposition at the next election for the issue of $200,000 bonds to erect an electric lighting plant was read and referred.

ROCKWOOD, PA.—Electric light is said to be in sight for Rockwood, a company having been organized with this object in view.

NEW BRITAIN, CONN.—The Young Men's T. A. B. Society of this city is going to erect a new building of its own. It is calculated to light the building by electricity and to heat it by means of furnaces.

PATERSON, N. J.—The plans for the new central station for the Edison Electrical Illuminating Company are so far advanced that the proposals for excavation, etc., will be advertised for in a few days.

KALAMAZOO, MICH.—An injunction was served on the Council to prevent the contract for the erection of a municipal electric light plant that has been under discussion for the last year. Illegality is alleged.

DAYTON, O.—The School Board is discussing the advisability of equipping the new high school with machinery for the purpose of producing its own lights and providing power for the manual training school.

MILLBROOK, ONT.—An agent of the Canadian General Electric Company has succeeded in securing the right-of-way on the streets and the promise of the council to consider the lighting of some of the streets by electricity.

KEWANEE, ILL.—On motion the Clerk was authorized to advertise for bids for 35 electric lights of 16-candle power each, and 100 gas lights of 16-candle-power each, said lighting to run for one year from October 1, as per moonlight schedule.

DAYTON, O.—The Board of Trade is considering the matter of cheaper electric lighting. The franchise of the Dayton Electric Light Company is by the year and does not extend through a term of years. The committee recommended the erection of a municipal plant.

JACKSONVILLE, FLA.—The General Electric Company has been awarded the contract for the city lighting plant. The apparatus contracted for includes two 120 kw monocyclic alternators, four 60-lt. Brush arc dynamos, with lamps, line wire and supplies, and complete steam plant.

COVINGTON, KY.—The directors of the Covington Electric Light Company have decided to increase the size of the plant. Two additional dynamos are to be placed in the power-house, with a capacity to light all of Covington, Ludlow Newport, Bellevue and Dayton, and all of Covington's suburbs.

FLORENCE, COL.—At a special election called for that purpose a franchise was granted to the Arkansas Valley Electric Company to erect an electric light plant for this city. The vote was almost unanimous. It is expected that work will be started upon this plant in fifteen days and that it will be running in sixty days.

KENSINGTON, PA.—The preliminaries are in progress for the erection of an electric light plant at Kensington. An ordinance will be presented at the next meeting of the Town Council for the franchises. The projectors are Messrs. Sidney Fuller and F. N. McKee, of Dubois; Capt. B. W. Weyman, of Tarentum; W. H. H. Piper, of Kittanning, and others.

JACKSON, TENN.—S. C. Lancaster, city engineer, may be addressed concerning a contract for 40 double arc, 2,000-c. p. lamps, with the privilege of 50, at the same price per light, for a term of five years. The city will grant an exclusive franchise for all arc and incandescent lighting, for both commercial and domestic use, for the same length of time.

PENSACOLA, FLA.—At a meeting of the directors of the Citizens' Electric Light & Power Company it was decided to purchase the Hudson property, between Paloford and Main streets, as a location for their plant. It was also decided to begin operations at once, and an order for the machiney will be given as soon as the details are decided upon, which will be at an early date.

CROSSDALE, ILL.—Willis Mellville Paine Harrington, Oscar E. Taylor, Werner Martin and Max Rathberger, of Crossdale, have organized a corporation to build water-works and an electirc light plant. The capital stock is $500,000. The business will be conducted on the cooperative plan. The electric light plant, to cost $10,000 and to serve a territory two miles square, will be commenced in three weeks.

CENTRAL ELECTRIC LIGHTING STATIONS are increasing in number in this country, the new edition of Johnston's Electrical and Street Railway Directory, an announcement of which appears in this number, contains a list of 2,344 electric light central stations with a paid in capital of $277,437,113. These are located as follows: United States, 2,124; Canada, 172; Mexico, 41; and Cuba, 7. The directory also gives a list of 7,475 isolated plants and 271 mining plants.

SPOKANE, WASH.—Councilman Clay has prepared a resolution calling for plans and estimates from the city engineer for the enlargement of the power-house at the new water-works. Mr. Clay says the power-house, as now designed, will not be large enough for the dynamos and other machinery for the proposed electric light plant to be built by the city. He thinks a majority of the council will favor the resolution. He estimates that it will cost the city $75,000 to put in the plant and erect its own wires and lights.

THE ELECTRIC RAILWAY.

HAMILTON, ONT.—The H. & D. Railway will soon adopt electricity as a motive power.

DANBURY, CONN.—Frederick Wardwell, who is to build the trolley road, has broken ground for the road bed.

CHARLOTTESVILLE, VA.—J. E. Moore has been awarded the contract for constructing the Charlottesville electric road.

HARTFORD, CONN.—The Hartford Street Railway Company will build a power-house on the east side of Commerce street, the building to be one-story high and 131 by 65 feet.

GETTYSBURG, PA.—The power-house of the Electric Light and Railway Company has been burned. The loss was $65,000 with no insurance. The plant was owned by a private company.

COLLINSVILLE, ILL.—An ordinance has been prepared granting right-of-way for an electric road to East St. Louis. Dwight Treadway is interested in the construction of the road.

SAGINAW, MICH.—The Union Street Railway Company will extend its lines to Carrollton and Milwaukee. Franchises have been granted by both towns. Work will be commenced at once.

LEWISTON, N. Y.—It is announced that an effort is to be made to revive the project of building an electric railroad along the waters' edge of the Niagara river from the state reservation to Lewiston.

SCRANTON, PA.—Work on the new extension of the South Side Street Railway was begun on Hickory street and will be continued until the end is reached, which will be within three months.

RUTLAND, VT.—A petition of the City Electric Street Railway Company, asking for a permit to construct an electric street railway through various streets in the city, was read. The petition was not acted upon.

BRAINTREE, MASS.—It is expected that a franchise will be granted to the directors of the Braintree & Weymouth Electric Street Railway Company for the construction of its line between Braintree and Weymouth.

WALLINGFORD, CONN.—Henry B. Todd is circulating a petition to the officers of the Meridan Railroad Company, asking them to build the road through Main street to the new cemetery. It meets with general favor.

PITTSBURG, PA.—The McKeesport & Reynoldton Company has completed a deal with the Dravosburg & Homestead Railroad, and an electric railway is to be built connecting McKeesport and Pittsburg via. the Second avenue line.

MANCHESTER, O—The proposed electric road between Manchester and

West Union will be commenced within three weeks. Frank E. Holliday of Ironton the promoter of the line, is securing the right-of-way.

CALDWELL, N. J.—An injunction has been issued restraining the Council and Mayor from any further action in the matter of granting a franchise to the North Jersey Traction Company, the hearing to take place October 1.

WASHINGTON, D. C.—The Washington-Great Falls Railway Company, offices at 1420 F street, will equip its lines with electric motors. J. P. Clark may be addressed for further particulars. The road is to be seven miles long

NETHERWOOD, N. J.—Mr. Spangenberg, of Netherwood, who has been hard at work trying to get the street railway to extend to Netherwood, is in a fair way to succeed. Adrian Riker, Newark, N. J., can probably give information.

POTTSVILLE, PA.—The Town Council has granted permisison to the Schuylkill Electric Railway to construct and lay one single track, with turnouts, and operate the same. R. S Chrisman is President of Town Council and H. R. Nichols is Chief Burgess

PHILADELPHIA, PA.—An ordinance was presented by Mr Huey, by request, permitting the Philadelphia & Ardmore Passenger Railway Company to lay its tracks, erect poles, etc., for the purpose of using electricity as a motive power on its cars.

PORT CARBON, PA.—A franchise has been granted by the Town Council to the Tamaqua & Pottsville Electric Railroad for permission to construct and operate an electric railroad on certain streets in Port Carbon. Robert Allison is president of the council.

BOSTON, Mass.—The Committee on Streets and Sewers will meet and give a public hearing on the petition of the Newtonville & Watertown Street Railway Company for the right to enter the city via North Beacon street, Brighton avenue and Commonwealth avenue.

FORT WORTH, TEX.—The Polytechnic Street Railway has been purchased by R. Vickery, S. S. Ashe and others. A new company will be formed under the title of the Glenwood and Polytechnic Street Railroad Company, and the line extended and rolling stock added.

SOUTH ORANGE, N. J.—A petition has been presented at the meeting of the South Orange Village Board of Trustees, from the New York Standard Construction Company, asking for a franchise to operate an electric railway on certain srteets in the village. The matter was laid over.

NEWARK, N. J.—H. M. Marsh, representing the North Jersey Street Railway Company, made a canvass of Hilton and North Irvington, to secure signatures of property owners to a petition for a franchise. Mr. Marsh says that work on the line will begin just as soon as the franchise is secured.

BENWOOD, W. VA.—The contract for the building of the electric railway of the Benwood Southern Street Railway Company, extending from Fourth street in Benwood through the narrows to Moundsville, was granted to the firm of Wareham & Highes, of Beaver Falls, Pa.

IRONTON, O.—Heald & Holliday, of this city, closed a contract with the Frazier Highland Construction and Equipment Company, of Chicago, Ill., for the construction of a railway line between Manchester and Winchester, O., a distance of 25 miles, and to equip the same, for a consideration of $200,000.

BUCKFIELD, ME.—The matter is being agitated and discussed of putting in an electric road from Buckfield, which is on the Portland & Rumford Falls Railroad, through the village of North Buckfield, West Sumner, North Paris to West Paris, connecting with the Grand Trunk Railroad at the latter place.

MT PLEASANT, PA.—Messrs. Frank and John Shephard, A. Shupe, of Mt. Pleasant, have asked of the Homestead Council the privileges of a franchise for the Mt. Pleasant Electric Light & Heating Company. This company proposes to build an immense plant and will furnish light for the East Homestead and Burns Station, Whittaker, etc.

PHILADELPHIA, PA.—The Northern Electric Passenger Railway Company has been incorporated, with a capital stock of $100.00, for the purpose of building a new trolley line which will run through the northren suburbs. Incorporators: A. C. Milliken, Pottsville; Chas. H. Davis, S. S. Evans, G. L. Martin, N. A. Waldron, Philadelphia, and others.

WALDEN, N. Y.—It is deemed possible that the electric railroad from Orange Lake to Walden will be built and completed within two months. William C. Weller and Isaiah W. Decker, who are well known and influential residents of Walden, say that a large majority of Walden people want to see the electric road extended to that place from Orange Lake.

McKEESPORT, PA.—The McKeesport & Wilmerding Electric Railway has absorbed the Citizens' Railway Company by purchasing all its property, which will be joined to and with the Wilmerding road a new railway system covering the hill territory and a route to Brinton. It also proposes to extend the Jenny Lind street line down Fremont street.

MILLBURN, N. J.—At the meeting of the Millburn Township Committee Edwin W. Hine and J. H. Baldwin, of Orange, representing the New York & Philadelphia Traction Company, applied for a franchise for the construction of a trolley line in Millburn township. It is intended to connect the line with the Consolidated Traction Company's Irvington branch.

SOUTH ORANGE, N. J.—Chairman Becker, of the Railway Committee, made a report containing many suggestions concerning a franchise to be granted for the construction and operation of an electric passenger railway within the limits of South Orange township, on Springfield avenue, to the Central Jersey Traction Company. The committee favors a double track.

PEEKSKILL, N. Y.—A company is being formed in Peekskill to build and operate an electric trolley railroad through the principal streets of the village. The directors are Charles E. Hammond, Dr. J. N. Tilden, T. D. Husted, J. W. Westbrook, Henry E. B. Armstrong and others, of New York. They have already purchased property for a power-house and car-sheds.

POTTSVILLE, PA.—A meeting of the citizens of North Manheim Township was held at the Seven Star Hotel to consider the matter of giving up the center turnpike for an electric railway extension. The committee appointed are L. W. Weissinger, James Deibelt, John Gerber, Wellington Hartman, George Heffner and Fred Beck. Another meeting will soon be held.

ST. LOUIS, MO.—A petition was presented in the County Court by George R. Webster, of Webster Groves, on behalf of Charles Greenwood, Joseph M. Fitzrot and W. M. Pearce, consulting engineers of the Westinghouse Electric Supply Company, asking for a franchise to build an electric road from the city limits at Greenwood to Meramec Highlands. $150,000 have already been subscribed.

BOUND BROOK, N. J.—An ordinance has been introduced in Council to authorize and empower the New York & Philadelphia Traction Company, a corporation incorporated under the laws of the state of New Jersey, to locate, construct, operate and maintain a street railway through the borough of Bound Brook, Somerset County, New Jersey, to be operated by electricity or other motive power, except steam.

MATAWAN, N. J.—Two parties representing different companies have been here this week to secure right-of-way for electric railways from Matawan through Keyport, Leonard avenue, Atlantic Highlands, and Navesink to Red Bank. A number of citizens have agreed to give the privileges asked free of charge. One party represented a New York electrical company and another a Monmouth county concern.

NORWALK, CONN.—Engineer Hill, accompanied by President E. J. Hill and Secretary W. P. Acton, of the Norwalk Street Railway Company, have been inspecting property along the east side of the river with a view to determine the feasibility of a route down Smith street, thence along the shore, going under the Consolidated tracks at Fort Point street. It would then be a comparatively easy matter to reach Gregory's Point.

SAN FRANCISCO, CAL.—The Market Street Cable Railway Company has purchased the Eddy Street Electric line, and will have a five-cent fare to the Cliff House. This is done to head off Sutro's electric road. It will not effect him, however, as he will give free tickets to Cliff Heights and baths to those traveling by his line, while others will pay 10 cents admission. The Market Street line is controlled by the S. P. R. R. Co.

MOBILE, ALA.—Mr. S. C. Schaffner has resigned his position as electrical engineer of the Mobile Light & Railway Company to become electrical engineer and superintendent of the Electric Lighting, Gas Light & Coke Company. Mr. S. M. Coffin, formerly electrical engineer of the Twin City Rapid Transit Company, of St. Paul and Minneapolis, Minn., succeeded Mr. Schaffner in September with the first named company.

PHILADELPHIA, PA.—Plans were approved by the Building Inspectors for the power station to be erected at Twenty-fifth and South streets for the Electric Traction Company. The structure will be of stone, iron and copper, and will be built on driven piles. There are to be four engines and four boilers in the building, which, with the machinery, will cost about $225,000. Chas. McCall has the contract and will begin work at once.

NORTH TONAWANDA, N. Y.—About a year ago a company was formed to construct and operate an electric railroad between North Tonawanda, Sanborn and Pekin, the officers being F. W. Arend, Buffalo, president; vice-president, Leo P. Sanborn, etc. But it is understood that a deal is now under consideration with Trenton, N. J., parties for the purchase of the franchise and the right-of-way. If this is consummated it is most likely that the road will be built this year.

BLANFORD, MASS.—Great interest is taken in a proposed electric railway to go from Russell to Blanford. George A. Hill and W. H. Allis, of Springfield Mass., are promoting the project and propose to raise the $50,000 necessary to build and equip the road if Blanford people will make the preliminary surveys and give the right-of-way over private grounds. A meeting was held and the following committee appointed: Dr. W. H. Dean, Deacon Wm. Hinsdale, Geo. A. Hill, Walter Oatley, J. E. Cooney, W. H. Lewis, E. W. Boise.

PHILADELPHIA, PA.—The Council's Committee on Street Railways met and agreed to report favorably the ordinance granting the West Philadelphia Passenger Railway Company and the Philadelphia Traction Company the right to erect poles, lay tracks and use electricity on streets in the Thirty-fourth Ward, or further extension of the Twenty-second street and Allegheny avenue passenger railway, and giving permission to the Union Passenger Railway Company to lay a single track on Cumberland street from Sixteenth to Seventeenth streets.

PATERSON, N. J.—The certificates of incorporation of the New Jersey Electric Railway Company and of the New Jersey Construction Company were filed. The first company has a capital stock of $2,000,000, and of that amount $27,000 is stated as paid in to commence operations. Stockholders are Chas. A. Johnson, Brooklyn; Geo. V. Turner, 12 East 119th street, New York city, and others. The capital stock of the construction company is $27,000; the company will build electric railways and buy and sell lands for the purpose of erecting and promoting electric railways. Stockholders Geo. V. Turner, New York; Frank Irving, Jersey City; John McGuiness, Ridgewood, and others.

THE NUMBER OF MILES of street railways in operation in the United States on January 1, 1894, according to a report to the Permanent International Railway Union, contained in the issue of the "Elektrotechnische Zeitschrift," dated September 6, 1894, aggregated 12,001 miles, of which 7,470 were operated by electricity, 3,308 by horses, 658 by cable and 565 by steam. Johnston's Electical and Street Railway Directory, just issued, and an announcement of which appears in this issue, gives 965 street railways in the United States and Canada with a paid in capital of $648,530,755. Of these 606 are electric railways, in which the capital invested is $423,493,219; while 359 are operated by horses, steam or cable, and in these $224,837,536 is invested.

Miscellaneous Notes

THE ADAMS TROLLEY SUIT.—The case of Dr. Wellington Adams, who has been suing for infringement of patents alleged to apply to all street railways using electric motors, was dismissed in the Federal Court at St. Louis on September 17.

A MEXICAN INDUSTRIAL EXPOSITION.—The editor of "Dixie," a prominent Southern industrial journel, desires expressions of opinions from manufacturers as to the advisability of holding an exhibition in the city of Mexico of American manufactures.

MR. B. J. ARNOLD, in accordance with the preference expressed by a plurality of members in Chicago and vicinity, has been appointed by the Council of the American Institute of Electrical Engineers, as local honorary secretary for that city, to succeed Mr. Edward Caldwell, resigned on account of his removal to New York.

TRANSFORMER SUIT.—The Westinghouse Electric and Manufacturing Company has commenced a suit in equity against the General Electric Company, for alleged infringement of the Shallenberger patent on electrical converters held by the complainants. An injunction until the suit is tried and damages for back profits are asked for by the complainants.

A FRENCH EXPOSITION.—The French Consul General at New York noti-

fies us that the Societe Philomatique of Bordeaux has organized an exposition to be opened on May 1, 1895. It will be international for England, Belgium, Switzerland, Italy, Spain and Portugal, and universal in three sections, of which one is electricity, to which exhibits from all countries are invited. Consul General Thebaut will be very glad to furnish the necessary information to prospective exhibitors.

WESTERN SENSE AND EASTERN NONSENSE.—The St. Louis Republic has the following in a recent issue: In a recent issue of a New York paper a half page of presumably valuable space was devoted to an attack on the trolley car idea. A sensational writer went into spasms over a speed of sixteen miles an hour in the suburbs, employing the following humorously vague sentence: "Onward, with noise and dust, and the wild clangor of the alarm bell ringing out on the night air, we plunged ever forward." In the name of all the superb trolley cars of this city, that put us into our homes in half the time formerly employed, did this writer expect to plunge any way but forward? Did he want a reverse motion, or did he think that it is within the line of the motorman's duty to experiment with the aeroplane idea? Such sensational nonsense as this is ever to be found in the Eastern papers.

ELECTRICAL STATISTICS.—From the new edition of Johnston's Electrical and Street Railway Directory, an announcement of which appears in the advertising columns this week, it appears that there are 5,444 manufacturers, dealers, electricians, etc., mentioned in the directory. The names are arranged in three ways: Geographically, according to cities and towns; alphabetically, according to the names of the dealers, etc., and finally according to the business in which they are engaged. The directory also includes a list of 2,344 electric light central stations, 7,475 isolated plants and 271 mining plants, prices paid for city lighting, lists of street railways, telegraph companies, telephone companies, district messenger companies, etc.

Personal Notes.

MR. ALFRED E. WIENER was married at Schnectady, N. Y., on September 20, to Miss Lilia D. Benedict, of that city. After a brief trip the happy pair will make their home in Schnectady.

MR. G. E. DUNTON, formerly with E. C. Allen & Company, of Augusta, Me., has accepted a position with the Bureau of Engraving and Printing, United States Treasury Department, Washington. Mr. Dunton will take charge of the electroplating work, and it is probable that this branch of the department will be considerably developed in the near future.

Trade and Industrial Notes.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, sends us a neat four-page card folder illustrating and describing the Fleming dynamo brush, and giving a list of the various sizes made, and of prices.

THE BROWN ELECTRIC AND MACHINERY COMPANY, of Little Rock, Ark., recently received a telegraphic order for two electric light plants to be installed in sugar refineries at Jeanerette, La. This makes ten electric plants this company has sold since August 1, and most of them have gone to Texas and Louisiana.

THE CORRESPONDENCE SCHOOL of Technology, Cleveland, O., has issued a little pamphlet containing 27 pages of "Hints to Engineers operating small electric light plants," written by Prof. E. P. Roberts and W. B. Stewart. This excellent little manual will be found very useful by those for whom it is intended and the price at which it is sold—10 cents—is merely nominal.

A. ALLER, 109 Liberty street, New York, in a 48-page pamphlet, describes a number of engineering specialties for use in manufactories, public buildings, hotels, etc. Among these are included the Korting injectors and jet pumps in numerous forms, noiseless water heaters, steam jet draught improvers, exhaust pipe head, pressure regulators of various forms, Curtis steam traps and water temperature regulators, etc.

J. JONES & SON, 67 Cortlandt street, have taken the agency for the Metropolitan district of the Iona Manufacturing Company. They will hereafter carry a heavy stock of Iona electric lighting goods. A new catalogue has just come from the press, copies of which will be mailed on application, as well as a list of the remaining stock of the defunct Alexander, Barney & Chapin Company.

THE WEBSTER CHEMICAL COMPANY, St. Paul, Minn., manufactures a liquid for coloring lamps, called Crystal Chemical Coloring. The process is simple, consisting of merely immersing the lamps in the solution. Any colored lamp can thus be produced in a few minutes. Among the large users of this process, we are informed, are the Chicago Edison Company and the Westinghouse Electric and Manufacturing Company.

THE NORWICH INSULATED WIRE COMPANY, 44 Broad street, New York, has issued a handsome 46-page catalogue of the large line of wires and cables of its manufacture. A number of colored cuts is given of various types of cables, and the pamphlet is well printed on a heavy paper of fine quality. Those unacquainted with the construction of cables will find it made very clear by the handsome full-sized cuts referred to.

WHARTON & WILLIAMS is the name of a new firm of electrical engineers and contractors which recently opened an office in Room 102, Liverpool and London and Globe Building, Newark, N. J. Mr. H. M. Wharton, formerly with the United States Electric Company at Newark, and Mr. R. C. Williams, Jr., formerly with the General Electric Company, are the members of the firm. They will engage in a general engineering and contracting business, for which their past experience well fits them.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has erected for the Mather Electric Company a new building 300 by 50 feet, equipped with improved electrical machinery, and a forty-ton electric traveling crane, especially adapted for building large direct connected generators for railway work. The unfinished castings are brought in at one end of the shop, and are loaded on the cars at the other end as finished generators.

THE MORGAN ENGINEERING COMPANY, Alliance, O., has received an order from the Fulton Iron Works Company, St. Louis, Mo., for a 40,000-pound lifting capacity overhead traveling crane, all motions of which are operated by electric motors. The order for this crane was placed after the most careful investigation into the construction of all other cranes of this character built by competitors. The crane is for serving the new erecting shop to be erected.

W. C. STERLING & SON, Monroe, Mich., the well-known cedar pole dealers, are now being rushed with orders, and are shipping to all parts of the United States. Orders have been received from the General Electric Company, Fort Wayne Electric Company, and many other smaller companies, for a large number of car loads, and, notwithstanding the number of orders, good poles for city use are being rushed out, thus keeping up their reputation as prompt shippers.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is having a large sale of its standard single push flush switch made up in gangs of from two to a dozen on a single large face plate for special work, where a handsome finish is expected. As the single pole, three-way and commutation switches are all the same size, they can be mounted very symmetrically, several on a single large face plate, and when the plate is finished specially to match hardware or fixtures, a handsome piece of work is secured.

MR. FRANK LEDROLE and Mr. J. W. Taylor, both of Atlanta, Ga., have formed a partnership under the name of the Ledrole-Taylor Company, as hydraulic and electrical engineers. Mr. Frank Ledrole has been engineer at the southern office of the General Electric Company for the past four years, and Mr. Taylor is the able southern agent of the Stillwell-Bierce and Smith-Vaile Manufacturing Company, of Dayton, O. Both men are well equipped and should do well in their new business partnership.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, is announcing to its patrons that it is handling the Kester Monitor arc lamp, representing the F. P. Little Electrical Construction and Supply Company, makers of this lamp in the West. Mr. W. E. Parker has returned to Buffalo, having had this line in charge during the summer months with headquarters with the Metropolitan Electric Company. A stock of these lamps is kept on hand in alternating, direct and constant current, ornamental and otherwise.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the sale of one of their 180-kw. improved new type multipolar railway generators, with complete station equipment, to the Hartford and West Hartford Horse Railway Company, for the Hartford, Conn., power house. The generator is to replace a 200-kw. generator of another manufacture, which, after a two-weeks' attempt on the part of its makers to make it run successfully, was thrown out. In thirty-six hours after placing the order the Mather Electric Company had the road running successfully, they, in that time, having removed the old generator and installed two temporary generators.

H. N. BATES MACHINE COMPANY, 240 Congress street, Boston, in a 160-page catalogue, gives cuts, descriptions and prices of a long line of machinery for the transmission of power, including numerous forms of friction clutch and other pulleys, friction clutch couplings, shafting, hanger, gears, etc. We learn from a note that this company will furnish, without charge, complete plans showing the best and most economical methods of transmitting power; defining the proper location of engines, boilers, pumps, hangers, shafting, pulleys, etc., for electric light stations, mills, factories and all other buildings wherein power is used; and, when the order is placed with them, will send, without expense, draughtsmen, who are experts in the above specialty, to lay out work and to make the necessary drawings.

MR. HENRY B. OAKMAN, 136 Liberty street, has made the following sales of Wenstrom apparatus during the past week: Raymond Oil Company, Franklin, Pa., one 50-kw. generator and motors for same capacity of various sizes; Dunkirk & Fredonia Street Railway Company, one 5-h. p., 500-volt motor; J. C. Frisbie, Fredonia, N. Y., one 2-h. p., 500-volt motor; American Lucol Company, Carteret, N. J., one 70-light 110-volt dynamo; the Standard Silk Company, Phillipsburg, N. J., one 28-kw. dynamo, 110 volts; the Standard Radiator Company, Buffalo, N. Y., one 22-kw., 110-volt dynamo; the Chapman Derrick & Wrecking Company, Buffalo, N. Y., one 120-light dynamo direct connected to Sturtevant engine; the Wilson Aluminum Company, Spray, N. C., two 100-kw., 70-volt generators.

THE PHOENIX CARBON MANUFACTURING COMPANY, 2134 De Kalb street, St. Louis, Mo., has been organized by Mr. S. G. Booker in connection with some St. Louis capitalists, the capital being $100,000. Mr. Booker was the organizer and the general manager until a short time ago of the Fidelity Carbon Manufacturing Company, controlled by the National Carbon Company of Cleveland, O., which some months since concluded to discontinue manufacturing at St. Louis and moved a large proportion of its machinery to Cleveland. The new firm has bought the plant formerly occupied by the Fidelity Company, and is now busily engaged in remodeling and re-equipping it with the most modern carbon machinery. It will be prepared to start about October 1 with all of the skilled employees formerly with the old company, Mr. Booker continuing in charge of the manufacturing end of the business.

Business Notices

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 18, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York).

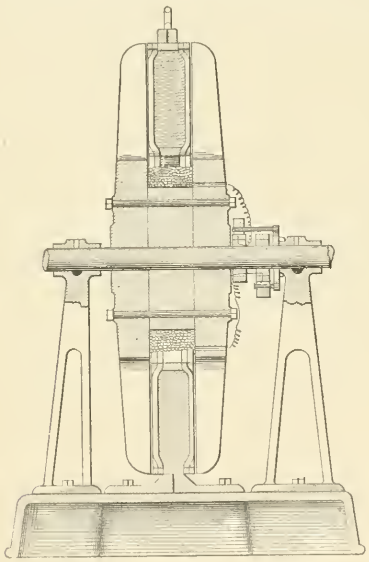
526,063. MULTIPHASE CONVERTER; H. O. C. E. Wagemann, St. Louis, Mo. App. filed July 5, 1892. This comprises a central core part with radially arranged extensions and a separable annular encircling piece fitted to the radial extensions.

526,064. ELECTRIC GENERATOR; H. O. C. E. Wagemann, St. Louis, Mo App. filed July 5, 1892. In an alternating current dynamo the arrangement of armature coils consisting in a plurality of independent coils equally divided on each side of a disk armature and placed circumferentially relatively to each other so as to sub-divide the phases of the machine into a number corresponding to twice the number of coils on one side of the disk armature. (See illustration.)

526,078. ELECTRICAL CONNECTOR; J. B. Henck, Jr., Brooklyn, N. Y., App. filed July 6, 1894. This consists of an inclosing tube, the interior cross section of which is divided into two parts, two pieces of unequal length filling such parts, and a contact making device attached to and within the longer of the pieces, the half of the circumference of the inclosing tube next to and around the longer piece being cut away through a portion of its length and the opposing half forming, with the longer interior piece, a tube inclosing the contact piece throughout its length.

526,172. ELECTRIC SWITCH; L. Winterhalder, Milford, Conn. Application filed February 17, 1894. The combination with a contact clamp, of a U-shaped spring having bearings on opposite sides of the clamp.

526,179. SIGNAL APPARATUS; J. P. Coleman, Swissvale, Pa. Application filed December 2, 1893. The combination of a signal operating mechanism



No. 526,064. Electric Generator.

detachably connected thereto, and a fluid pressure mechanism controlling the connection between the signal and its operating mechanism.

526,182. GALVANIC CHAIN; F. Fritsche, Berlin, Germany. Application filed May 12, 1894. A voltaic chain consisting of links of zinc and copper connected electrically by links of absorptive material, whereby an electric current is produced when in conjunction with the human body.

526,083. ELECTRIC MOTOR; A. W. Meston, St. Louis, Mo. Application filed August 1, 1892. The combination with the armature of a choking coil or coils secured to and rotating with the armature and means for throwing the coils into the motor circuit. (See illustration.)

526,099. APPARATUS FOR AND PROCESS OF EXTRACTING GOLD OR SILVER FROM ORES; P. Danckwardt, New York, N. Y. Application filed April 2, 1894. This consists in subjecting the ore simultaneously to the action of cyanide of potassium, an alakli sulphide and to electrolysis.

526,139. TELEPHONE TRANSMITTER; H. I. Baldwin Chicago, Ill. Application filed January 30, 1892. The combination of a horizontal bar electrode, a series of electrodes suspended by separate arms from a horizontal rod, adjustable in position by means of slots and clamping nuts.

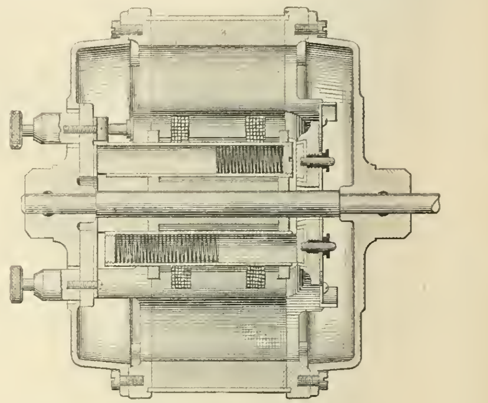
526,141. PNEUMATIC TUBE FISHER; W. C. Bloomer, Brooklyn, N. Y. Application filed April 10, 1893. The combination in an insulating tube fisher of a vacuum pump, flexible connection tubes and a rigid tube and cart.

526,142. BOND FOR ELECTRIC RAILWAYS; D. D. Book, Brooklyn, N. Y. Application filed July 14, 1894. A rail provided at or near its end with a metallic projection or bond plate forming an integral part of the rail

526,145. INCANDESCENT ELECTRIC LAMP; D. J. Cartwright, Boston, Mass. Application filed January 27, 1894 A socket having an extension provided with a plug fitted to serve as an internal coutact, and an internal contact consisting of a screw having its inner end in engagement with the plug.

526,169. ELECTRIC MOTOR; E. Thomson, Lynn, Mass. Application filed August 30, 1884. The combination with a motor, of a stopping switch, a detent therefor, and devices responsive for changes in the speed of the motor for controlling the detent, whereby the switch may be released to stop the motor at a predetermined increase in the speed.

526,168. SIGNAL APPARATUS; G. L. Thomas, Brooklyn, N. Y., and E. C. Seward, Montclair, N. J. Application filed January 22, 1894. This comprises a plurality of circuit making and breaking devices, a track treadle for each movable contact piece under the control of the treadles to close



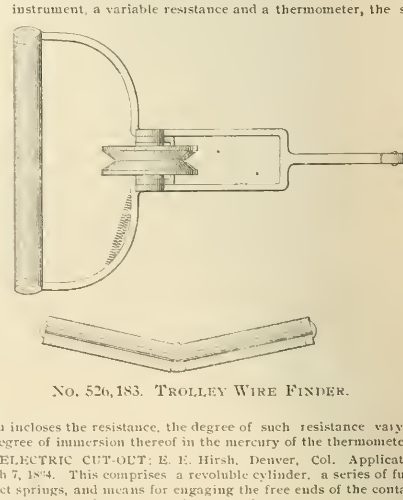
No. 529,083. Electric Motor.

one break in each circuit and movable contact pieces indirectly under the control of the treadles to close a second break in each circuit.

526,170. DYNAMO ELECTRIC MACHINE; D. H. Wilson, Chicago, Ill. Application filed August 17, 1893. The combination in one machine of a motor and generator, the armatures of which are fastened to the same shaft, the field magnets of the same motor and generator being magnetically connected but electrically entirely separated from each other.

526,183. TROLLEY WIRE FINDER; E. Gale, Peoria, Ill. Application filed November 21, 1892. This comprises a grooved contact wheel and revoluble finder sleeves extending laterally beyond the vertical sides of the contact wheel. (See illustrration.)

526,220. ELECTRIC INDICATOR; C. J. Coleman, Chicago, Ill. Application filed December 8, 1893. The combination of a standard cell, a current measuring instrument, a variable resistance and a thermometer, the shank of



No. 526,183. Trolley Wire Finder.

which incloses the resistance, the degree of such resistance varying with the degree of immersion thereof in the mercury of the thermometer.

526,227. ELECTRIC CUT-OUT; E. E. Hirsh, Denver, Col. Application filed March 7, 1894. This comprises a revoluble cylinder, a series of fuse wires, contact springs, and means for engaging the free ends of the contact spring to prevent backward movement of the cylinder.

526,356. DIAL TRANSMITTER; F. Pearce, New, York and J. Broice, Brooklyn, N. Y. Application filed June 11, 1894. This comprises a rotary circuit closer and numerous circuits into which the circuit closer directs currents in succession two or more dials and their rotating and circuit closing devices and automatic mechanism for bringing the second dial mechanism into action after the first dial has completed its movement.

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CONTENTS.

A COMMENDABLE POLICY.

The American Institute of Electrical Engineers by having on its programme at the recent monthly meeting two papers, one of a strictly scientific character and read by title only, and another for reading at the meeting of a class that appeals to the electrical profession generally, inaugurated a wise policy, which, we trust, will be adhered to. Papers like that of Dr. Bedell and Mr. Kinsley are not of a character to attract the large audiences which are so useful in maintaining interest in the Institute, and yet are most valuable additions to the *Transactions*. By having, therefore, on the programme, as in the present instance, two papers, one of a character similar to that just referred to, and another likely to draw a large audience, the preparation of the former by members can be encouraged more strongly than in the past, thereby adding largely to the value of the *Transactions*, and the interest in the work of the Institute furthered by the latter through attracting its members more regularly to the meetings.

L'ECLAIRAGE ELECTRIQUE.

A few weeks ago we announced the temporary suspension of *La Lumiere Electrique*, and it now appears that the publication will cease entirely, and with it, of course, that of its satellite, *Electricite*, a wretched little sheet which was apparently published chiefly to obtain exchanges for nothing. In order to fill the vacancy left by *La Lumiere Electrique*, we are pleased to find that a new journal called *L'Eclairage Electrique* has just been started by Dr. P. H. Lebedoer, the first number of which is dated September 15th. It will contain articles from the same writers and collaborators as its predecessor, and the general appearance of the journal is the same, except that it is published in less elaborate style. We regret noticing the absence of those numerous and excellent illustrations for which its predecessor was noted, although the first issue is by no means without illustrations. We find also that an objectionable feature has been continued, the absence of references with dates to the originals of articles which are abstracted from other journals and publications. Abstracts are generally very acceptable to the busy man, but there are many readers who also like to look up the originals, and it is always of interest to know the original date of publication. That several articles in its first issue are from one to four years old, is perhaps not as objectionable in a purely scientific journal as it would be in one claiming to publish news and new matter. A feature which shows the broad mindedness of the editors, and which will please Americans, is that free use is made of scientific matter originating in America. Our new contemporary has our best wishes for its success, though we fear that its high price will form a serious barrier to a large circulation in this country.

THE WESTON STANDARD CELL.

The well known Clark cell has been recognized as a standard to such an extent that it has been recommended and adopted by several Governments as the best reproducable standard of E. M. F., not as a unit, of course, but as a standard by means of which the volt can be reproduced. Any other cell which can be shown to be better might therefore be said to be better than the best,—than the best of that time. The chief objection to the Clark cell is that its temperature coefficient is so great that it must be taken into account, involving considerable trouble and calculation, and at the same time introducing an element of error and uncertainty. Some years ago Mr. Weston showed that by substituting in the Clark cell cadmium and its compounds in place of zinc and its compounds, this temperature coefficient became practically negligible. Although this cell has already been described in these columns, we mention it

again to call attention to a report just published, which comes from that excellent and model, Government Institution, the German Reichsanstalt, and containing the results of the most elaborate, impartial and most carefully made tests yet published on the behavior of the Weston cell. The chief results will be found in an abstract in our Digest, the sum and substance of which is that the Weston cell is in no feature inferior to the Clark cell, and that in several very important features it is far superior. This, coming as it does from such a high authority, we will even say from the highest authority of the present time, is certainly a high tribute to the inventor of that cell, as well as to American scientific research. It is especially so, as it comes from the Germans, who are second only to the English in hesitating to acknowledge the scientific work done in this country. The English will doubtless claim Mr. Weston as an Englishman, but like Elihu Thomson, Mr. Weston has been living in this country a long time and has done all his electrical work here, which makes such a claim absurd, especially when directed to his recent accomplishments.

COLD LIGHT.

One of the most fascinating problems which it will probably be the good fortune of some electrician to solve, is to do that which the tantalizing little firefly knowing nothing about the subject, can do before our eyes, while the greatest scientists on earth are failing in almost every attempt to imitate it. The almost inestimable value of this discovery, which we feel sure will be made sooner or later, is so well recognized that there is no need to dwell upon it again. But while waiting to chronicle the event of its discovery, it gives us pleasure to note any success in this direction, even though it may be only an approach at a solution. Under a somewhat obscure title in a recent issue of a foreign journal devoted to pure science, we find that Prof. Ebert has deduced the laws according to which apparatus should be constructed to produce light by means of high frequency electric currents, without converting most of the energy into heat. A brief extract of his paper will be found in our Digest this week. He has obtained a light of about one-thirteenth of a candle, with an expenditure of only about 1 1500th to 2000th part of the energy required in the amylacetate standard candle lamp. The comparison would, of course, be somewhat less favorable with the incandescent electric light, but nevertheless the difference would still be very great. The light efficiency of an incandescent lamp is said to be about 5 per cent., which means that 95 per cent. is converted into heat and 5 per cent. into light; from this it would appear that the greatest possible efficiency which can be expected is twenty times as great as that of the incandescent lamp, assuming that the 5 per cent. which is now converted into light is converted as efficiently as it is in the cold phosphorescent lights. He furthermore expresses the belief that by proportioning the apparatus according to the laws which he gives, very bright lights (how bright is unfortunately not stated) can be generated with only an expenditure of some millionths of a watt. We hope he, or some one else, will soon prove the correctness of this, in which case the law suits regarding incandescent lamps will cease and incandescent and arc lamps will be relegated to the museums and college laboratories as illustrations of what the past generation did not know. How much of this discovery, if it turns out to be a real discovery, is due to Tesla, would appear after a more thorough discussion of it; at present the researches of Ebert seem to be a mere development of the work started by Tesla in this country.

ELECTRO-THERAPEUTICS.

The great extent to which electricity is applied in medicine is well indicated by the report published in this issue, of the meetings of the National Society of Electro-Therapeutists and of the American Electro-Therapeutic Association, recently held in New York City. In fact, if the remarkable number of papers read were in itself accepted as a criterion the conclusion would follow that the work being accomplished in this branch much exceeds in extent that done in the industrial departments of the science. Such a conclusion, of course, would be wrong, for in the latter a broad principle once established is easy of application, but in dealing with the complex human organism, but little can be predicated from principles and the treatment for each case must be established independently. Our non-medical readers will doubtless be somewhat puzzled by the medical electrical nomenclature, but it is encouraging to know that the obsolete nature of this terminology is apparently recognized by the medical profession, for it formed the subject of the address of the president of the American Electro-Therapeutic Association. The lines along which to proceed in the desired reformation are given in a paper by Houston and Kennelly, reprinted elsewhere, which, if followed, would place the terminology of the electro-therapeutist on a parity with that of modern science and give a basis that would not in the future necessitate another change. An interesting paper by the same authors read at one of the meetings challenges, and with reason, the recent statement of d'Arsonval in regard to electrical executions. While the conclusions of the French physiologist are admitted as to the desirability of applying treatment to those shocked by electricity, it is shown to be quite another thing to assert that criminals may be revived after being submitted to the electric current in the execution chamber of one of the New York prisons. The remarks of Prof. E. Thomson on the effects of high frequency discharges passed through the human body are of interest as an expression of opinion from such an authoritative source on the various theories that have been advanced on this subject. As will be seen, Prof. Thomson does not endorse the view that immunity from danger is due to the current passing wholly on the surface instead of through the interior of the body, nor the other one that such immunity is due to a condenser effect. The speculation of Prof. Dolbear in regard to the relation of the human organism and magnetism is a bold one, and still more daring is the assertion "that though death may be for the benefit of the race, it is not necessary for the individual." Many other of the papers will be found of more or less interest by the non-medical electrician, which in itself shows a community of knowledge which formerly did not exist, and which will increase when a common language is used for expression.

Resuscitation from Electric Shock.

In connection with the article on this subject by Dr. A. H. Goelet, published in the Electrical World of Sept. 8th, the following paragraph from a very complete report by Dr. Alex. McAdie, of the U. S. Weather Bureau, on "Protection from Lightning" may be of interest:

"If you should be in the vicinity of a person who has been struck by lightning, no matter if the person struck appears to be dead, go to work at once and try to restore consciousness. There are many cases on record proving the wisdom of this course; and there is reason for believing that lightning often brings about suspended animation rather that somatic death. Try to stimulate the respiration and circulation. Do not cease the effort to restore animation in less than one hour's time. For an excellent illustration of a case of severe lightning shock and recovery, due, it would seem, to prompt action by the medical gentlemen present, all who are interested may consult the 'Medical News,' August 11, 1888. A number of cases corroborative of this view are on record in various medical journals."

European Red Tape.

It is stated that the reason why a certain electrically driven carriage from Italy could not take part in the recent competition held in Paris, was that the French custom house officials could not make up their minds what duty to charge for electrical carriages and therefore could not admit this one into France.

Flying Machines.

Lord Raleigh, in discussing the subject of flying machines at the recent British Association meeting, said that "of the five problems to be solved in order to make a successful flying machine, Mr. Maxim has already solved three." Mr. Maxim announces that he now proposes to solve the remaining two.

A Phonograph in Clocks.

According to a French journal, a Geneva firm is manufacturing clocks which talk the hour instead of striking it.

Hermann von Helmholtz.—The Man and the Teacher.

BY W. F. MAGIE.

In one of the many notices of Helmholtz which have been called forth by his recent death, it has been well said that he was distinguished from his German contemporaries by the wide range of his sympathies and by the versatility of his effort. This is certainly true. It is tantamount to saying that Helmholtz was a man of genius, while most of his contemporaries are men of talent. He was a physicist by nature, while they are physicists by education. The German system of education is such that a man of talent and industry is trained to work to the best advantage, and is stimulated to an amount of productive activity which in any other country and under any other system is only the result of individual genius. By confining their efforts within one, and sometimes a very narrow, field, by making themselves masters of everything that can be known in that field, such men, second-rate men, we might call them, are enabled to contribute important additions to science. Their work is, however, rarely if ever epoch-making, and it is often open to the charge of being narrow and out of touch with the work of others. The genius in Germany, on the other hand, is like the genius anywhere else. His mind is open to influences coming to him from different quarters, his glance perceives opportunities for progress in different directions. He distinguishes between fundamental and subordinate questions, and by concentrating his effort upon the former, he builds structures upon the accumulated labors of lesser men which raise science to a higher level. It is in this way that Helmholtz differed from so many of his able and distinguished contemporaries. He was versatile with the versatility of genius.

HERMANN VON HELMHOLTZ.

It is commonly said that Helmholtz was at once a metaphysician, a mathematician, a physiologist and a physicist. Owing to the circumstances of his early life, he became a physician, and some of his first efforts at original work were in the line of physiology. But if the work by which he will be remembered be examined, it will appear at once that he was at heart a physicist, and that all his work in other directions was subordinated to his work in his chosen field. His metaphysical papers dealt with the theory of perception, the one portion of metaphysics which is all important to the physicist, if he would co-ordinate his theoretical study with the results of his observations and calculations. His mathematical work dealt with the fundamental data of physics, time and space, or with questions which naturally arose during the study of physical problems. Much even of his physiological work dealt with the physical questions suggested by the study of the eye as an optical instrument and of the ear as an acoustical instrument. The great bulk of his work was, strictly physical and it was by his versatility and power within the domain of physics that the force of his genius was most clearly shown.

If a scientific man's title to fame can ever be established by one achievement, that of Helmholtz will securely rest on one of the earliest of his productions, the immortal paper on the conservation of energy. This paper was not the first in which this principle was propounded. It had been discussed by Joule, Mayer and Mohr, to say nothing of the various hints of it which active investigation, enlightened by modern knowledge, has discovered in the works of older writers. But Helmholtz's paper has a character of its own. Joule devoted himself to prove the equivalence between heat and energy, without establishing the universality of the principle; Mayer expounded the principle but gave no adequate reasons for its acceptance; Mohr developed a speculative view of the structure of bodies and their energy relations, which in his time, at least, was a pure speculation and nothing more. With a wider philosophical outlook than Joule, and with a more thorough grasp of physical facts and principles than Mayer, Helmholtz treated the conservation of energy as a general principle, exhibiting its relations to attracting systems, to heat, to electrical and chemical actions, and to organic life. His arguments were drawn from all departments of physics, they were logically reasoned, and were based on known facts. One might have been pardoned for refusing assent to the principle when supported only by Joule's mechanical value of heat, or by Mayer's or Mohr's speculations, but from Helmholtz's argument there was really no escape. It is to him, more than to any other, that science owes the principle of the conservation of energy in its present form.

The paper on vortex motion in fluids should be reckoned as the next in importance of Helmholtz's contributions to science. It is interesting in itself as an extension of hydrodynamics, but its value can only be appreciated when we remember that it served as the starting point for much of the modern theoretical physics. Its services in the development of Maxwell's theory of magnetism and electricity, and in furnishing the basis for the vortex atom theory of matter proposed by Lord Kelvin, can hardly be over stated.

By the invention of the ophthalmoscope Helmholtz opened the way to a scientific study of the eye in health and in disease, and in his treatise on physiological optics he carried that study to a high degree of perfection. In a similar way he enlarged the scope of the ancient science of acoustics. By his analysis of complex tones, he showed a beautiful order in what had been before considered a chaos, and united the science of acoustics and the art of music by the most intimate relations.

Thermodynamics owes to Helmholtz considerable extensions, especially in the field of the relations between electrical and chemical actions and heat. His study of electric currents is also of great importance and his introduction of the kinetic theory of matter into optics and his explanation, on that theory, of anomalous dispersion should not be passed without mention.

In Germany every investigator is also a teacher. Scientific men are glad to receive the stimulus which comes from the necessity of presenting their views to students, and the students receive from them an incentive to original work as well as a model of the way in which that work should be conducted. It is not necessary that the lecturer should have all the graces of the platform orator or that his experimental illustrations should be always striking and brilliant. It is his business to think before his class and to instruct and excite them by an exhibition of the working of the scientific mind. In our ordinary sense it can hardly be said that Helmholtz was a great teacher. His lectures were well delivered, in beautiful and intelligible language, but there was a certain halting and uncertainty, a feeling, as it were, for the thought and a strange inaccuracy in stating the details of an argument, that in a popular lecturer or in one of our college professors would be set down to a failure to grasp the subject. His blunders in the use of the sim-

plest mathematical expressions were notorious; and, at least in the later years of his professorship, when the preparation of his experiments was left to his assistants, it was no uncommon thing for the lecture to come to a standstill, while refractory apparatus was being pushed and pulled, adjusted and readjusted, in the effort to present an illustration which would not come. In the laboratory, also, there was none of that constant personal supervision to which some of the German professors devote so much of their time. The daily tour of the laboratory was very brief, and a student might work for weeks without receiving a visit. But in the highest sense of the word, Helmholtz was a great teacher. His presence was an inspiration. His lectures opened to his hearers the view of a great mind working on problems which had for it a living and not merely a didactic interest. Even the commonplaces of elementary physics were illumined by the light of genius. In the laboratory, when the worker was in difficulties and asked for help, Helmholtz's advice was always pertinent and valuable, and when he was making progress, no encouragement could be more gratifying than the interest with which his report was listened to and the "good" with which the interview terminated. Helmholtz's students used to complain sometimes of the lack of attention which they received, but it was generally true that they were neglected only when their work was making no advances and when their teacher's visit would have been of little or no assistance, either for advice or for encouragement. His fertility of mind in suggesting new and important problems for investigation was remarkable. The work that was turned out of the Berlin laboratory under his directorship was of a high order of merit and of permanent value. His vast reputation as a thinker, his sympathy with good work and his evident scorn of poor and useless work, his shrewd advice and his warm appreciation of success, combined to make him what a great teacher should be, a leader of the minds of others.

BY C. RIBORG MANN.

In the death of Hermann von Helmholtz the world has lost not only the greatest scientist and teacher of his generation, but also one of her kindest, most genial, and truest men.

All students of natural science are so familiar with the many new discoveries in that realm which were the results of his labors that I will not attempt to give any further information on that point.

It is not only because he was a great scientist that he commands our homage, but also as a great teacher and man that his memory will be cherished with greatest respect. Notwithstanding all his attainments, all the honor that was showered on him from every side, he never lost that quiet modesty which is one of the marks of genuine greatness and true genius. In society, just as everywhere else, he was a man of few words. He did not have much to say in a general conversation, but what he did remark was very much to the point. As a teacher he was an inspiration to all who came into his laboratory. It never made any difference what your trouble was, what bug you had found or was hunting on your apparatus, Helmholtz was always able and ready to help you. Nevertheless he did not seem to regard himself as any great authority. Often I have seen him make a long mathematical deduction and bring out the wrong result. When this happened he was never in the least embarrassed, but would remark, "Well, gentlemen, I seem to have made a mistake here somewhere." Then he would either go back and work it over, or more generally the case leave it to the students for correction.

He always liked the American students and said that they gave him the best papers at examination, as they arranged their thoughts in a much more connected way than the most of the Germans. He made many friends here in America when he visited the World's Fair, every one being attracted by his genial, kindly manner. It was his first trip to America, and, though he dreaded it beforehand, was afterwards glad that he had taken it.

He was a man of deepest personal sympathies. No one could listen to his words when he spoke at the funeral of his colleague, Prof. Kundt, and see his emotion, without being impressed with the fact that they were heartfelt words and deep emotions that stirred him.

Little did he think at that time that he would be the next great scientist to pass onward; little did we imagine that this year would add to the names of our great masters Herz Tyndall, and Kundt, that even greater name of Helmholtz on the list of the distinguished physicists who have let us.

But he has gone and we have lost the inspiration of his presence—an inspiration which is at best only imperfectly felt in his works and his memory.

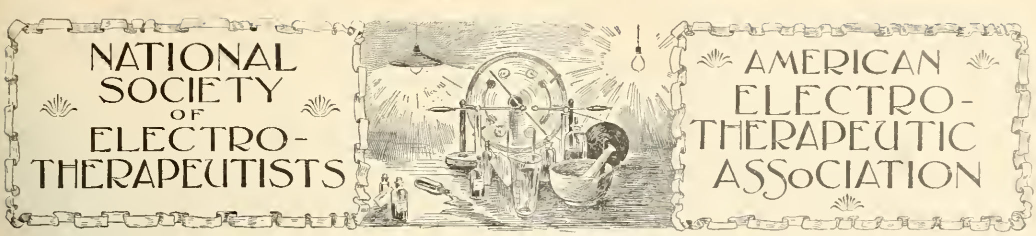
Municipal Electric Lighting at Glasgow.

(From our own English Correspondent.)

The honorable record of our municipalities in the matter of financial administration has rendered the public somewhat indifferent to the possibilities of corruption involved in the general undertaking of electric lighting by them. The main objection urged against municipal electric lighting was that municipalities were at any rate sure to so mix up their gas electric lighting and other accounts that it would be impossible to find out exactly what was the loss or profit on any one of the constituent items. So far, however, even this foreboding has not been fulfilled; indeed, clear as are the accounts of our electric lighting companies, those of our electric lighting municipalities are if possible still clearer. A good example of this is the financial statement that is published by the Electric Light Committee of the Glasgow Town Council for the year ending May 31, 1894. In these accounts the capital expenditure is allocated under no less than 14 different headings, so that it is possible, without any trouble, to put one's finger immediately upon any undue source of expense. Not content with this, however, the committee have commenced in a most business-like way to write off large sums for depreciation, notwithstanding the newness of the plant, and the fact that had they refrained from doing as they might well have done, the electric lighting venture would have resulted in a handsome profit instead of a small loss. The depreciation, moreover, is also carefully allocated to the different items of capital expenditures, 1 per cent. being written off buildings, 7½ per cent. off machinery, 10 per cent off accumulators, and 2½ per cent. off mains. At the same time that one must gladly confess that these accounts and others of the same kind are perfectly satisfactory as regards straightforwardness, and even as regards profit and loss, seeing that in the second year of the undertaking the loss has been reduced to a little over £600, with £4,400 set aside for depreciation, £3,400 devoted to interest on loans, and £1,200 devoted to the loan redemption fund, yet notwithstanding several favorable circumstances, the Glasgow undertaking does not show that municipal management leads to anything noteworthy in the matter of economy. The price per kilowatt hour was until recently 7d., and only since the first of June has it been reduced to 6d. and this at a place where coal is cheap and fuel is supplied to the central station at a normal price in the shape of gas coke from the municipal gas works. The price now ruling in London, where coal and everything else is dear, is 6d. with a day supply at 4d. Again, notwithstanding the fact that some 30 per cent. of the energy generated by the station supplied is applied to public lighting purposes, involving a steady load for long and definite hours, the Glasgow Municipality is unable to generate a kilowatt for less than 2d., whilst in Kensington, with all the disadvantages under which electric lighting labors in such a neighborhood, the figure is only ¼d. more. When we come to the total expense of generating a kilowatt hour, the Kensington Company is able to do it for 4¼d., whilst the Glasgow Municipality is unable to do it for less than 4¾d. I may mention that the system of both these concerns is identical (three wire system with accumulators) and their capital expenditure and output are of the same order of magnitude. Whether due to bad meters and other measuring instruments or to an inferior system of underground mains, the percentage of energy unaccounted for at Glasgow is abnormally high for an English electric lighting undertaking. Last year 26 per cent. of the energy generated was apparently lost. This year, it is true, considerable progress has been made in diminishing this loss, but it still stands at over 16 per cent. To give an idea of the Glasgow undertaking, I may mention that the capital expenditure up to date has been close upon £120,000; last year the output in kilowatt hours was over 850,000, and the revenue £18,000, the number of customers connected to the mains being close upon 400. It is certainly satisfactory that municipalities, if not making a marked financial success of their undertakings, are at any rate managing them with ordinary ability and extraordinary honesty, since before another twelve months have elapsed the number of our municipal undertakings will be portentous. Within the next few months new municipal stations will be in operation at such important towns as Leicester, Worcester, Cardiff, Ealing, Cheltenham, Belfast, etc.

A Doubtful Compliment.

In a communication to a London contemporary, an Englishman remarks: "Actual experience, even though American, is a safer guide than purely theoretical considerations."



THE NATIONAL SOCIETY OF ELECTRO-THERAPEUTISTS.

The second annual meeting of the National Society of Electro-Therapeutists was called to order by the president, William Harvey King, M. D., of New York City, at the Berkeley Lyceum, on Thursday, September 22, at 11 A. M. The members present represented almost every State in the union.

The president's address, "Electro-Therapeutic Teaching," was an able argument in favor of having this subject taught in every medical college in the land.

"The Electrical Treatment of Appendicitis," by W. N. Williams, M. D., San Jose, Cal., was the first paper read. As he had used it in connection with other remedies, he could not say that his patient was benefited by the galvanic current as he applied it.

The next paper was on "How to Measure the Faradic Current," by Harry F. Waite. In order to accurately measure the current there should be known the rate of alternation, the amount of current in the primary coil, the distance the secondary covers the primary and the details of construction of the secondary coil. In case the old style vibrator is used in the primary circuit, it is only necessary to know the amount of current in the primary coil, the distance the secondary covers the primary, and the details of construction of the secondary coil.

"An Investigation of Interpolar Action in Galvanic Currents," was the subject considered by William L. Jackson, M. D., of Boston. The doctor used the zinc-carbon cell, bichromate of potash solution, arranged in two batteries of 30 cells each, Waite & Bartlett pattern. A piece of fresh beef 12 centimeters long by 4° square, carefully prepared so that the fibres ran lengthwise, was fastened by rubber bands to a glass plate and two bare copper electrodes were applied, one to each extremity, and a current, ranging from 10 to 60 milliamperes, was passed through the meat. The resistance varied with the different currents used, diminishing with the stronger current. The negative end of the meat was moist and juicy and apparently unchanged and the metal electrode was unchanged and easily removed; but the positive electrode was adherent and corroded, and the surface of the meat had an apple-green stain which extended into the tissues. The current was now increased to from 105 to 650 milliamperes, and the positive end of the meat was affected as before; but, at the spot where the negative electrode was in contact, there was a brilliant crimson color, and the untouched meat was decidedly paler. The ends of the meat were now covered with moist clay and the electrodes applied to the clay. Seventeen milliamperes were passed; the resistance was increased to 224 ohms. The meat was now trimmed so as to make an hour-glass contraction having a diameter of 1 centimetre. A current of 5 milliamperes now met with a resistance of 760 ohms. As soon as 60 milliamperes were allowed to pass the meat began to smoke, turned white, was too hot to be comfortably handled and drops of serum began to ooze out. The color now became brownish, juice more abundant, a sizzling was heard and an odor of cooking meat was perceptible. The area of change was limited to about one centimetre, but it gradually broadened at the end of three minutes and was fully two centimetres wide. Suddenly there was a slight explosion at the point of most marked action and immediately the current began to decrease, and at the end of 5 minutes the current was 150 m-a and shortly after it feel to zero. The negative electro was now found to be bright and clean, with an increased moisture around it. The positive electro was adherent, and it was removed with difficulty; the metal was corroded and the clay was dry and clung tenaciously to the meat. The ends of the muscle had a whitish, sodden appearance, but it was deeper at the positive end. Upon dissection the interior was found to be quite warm, the bright red had disappeared and it had a less juicy look. All resemblance of muscular fibre had disappeared from the narrow portion, and it was of a yellowish-brown color, tough and grizzly and felt like a hardened cord. This clearly shows that there was an electrolytic action between the poles.

President King read two papers, one on "Some Observations on the Influence of Electricity in Muscular Developement," in which he gave his experience with faradism and the galvanic current to develop strength of muscle of the forearm. The conclusions were in favor of the galvanic current. "The Clinical Uses of Electricity in Muscular Development," treated of the congenital defects in muscles. By treating the motor points of the muscles there was an increased nutrition and strength and peevish, fretful children had become cheerful, where there had been a lack of strength or growth of a muscle and it was unable to cope with the antagonistic muscle or muscles; causing a slight deformity, particularly noticeable when the child tried to run or step quick, sometimes causing him to tumble. These cases which the doctor treated showed a marked improvement in their mental condition as well as in the muscles.

"In a paper on "Hints on the Use of Electricity in Gynæcology," by Flora A. Brewster, M. D., of Baltimore, it was shown that uterine hemorrhage is promptly relieved by the galvanic current on account of the stimulus given to the nervous system, sending increased vital forces to the blood vessels, and so increases their tone that their calibre is diminshed and their walls are so strengthened that they retain the blood and send it promptly on its course to the heart. A strong galvanic current passed through the small intestines from the six lower dorsal vertebræ will constipate the bowels. A weak galvanic current in the same direction will act as a tonic and the peristaltic movements will be increased. If all the spinal nerves are galvanized the heart's action will be increased. Galvanization of the vagi stops the heart's action. If the current is directed from the spine to the cervix (positive to the spine and negative to the cervix) most powerful contractions of the uterus will occur. Galvanization of the blood vessels diminishes their calibre. The positive pole will coagulate blood and the negative will make t more fluid. The galvanic current has a chemical effect and the faradic has largely a mechanical effect. Faradic currents from a short, coarse wire will excite more acutely the sensibility of subcutaneous organs. The current from the coil of long, fine wire acts especially upon the cutaneous sensibility and penetrates more deeply into the tissues. The current from the coarse coil is more easily localized in its action.

F. M. Frazer, M. D., of New York, in a paper on "Radical Electrolysis," expressed the belief that in radical electrolysis there is a process different from anything heretofore used, and it is particularly adapted to those conditions where the negative pole is indicated and local action on the mucous membrane is desired. It is not to replace or displace anything we now use, but it is designed to add one more specalized method to the armamentarium of the electro-gynecologist.

M. Milton Weill, M. D., of New York, exhibited and explained an electrical endoscope, laryngoscope and stethoscope, and explained their uses. The endoscope has a small electric light of about one-eighth candle power.

"Post-Diphtheretic Paralysis Treated by Electricity, by William L. Jackson, M. D., of Boston, treated of a case of the disease where static electricity, negative insulation, positive breeze, and massage and sparks were applied to the weakened muscles and to the spine; length of treatment 20 minutes, followed by half an hour in a recumbent position. There were intervals of from two to six days between treatments. Rapid progress was made in the improvement and in two months the patient reported that she had danced. She was discharged cured in six months.

"Brief Researches on the Action of Galvanic, Faradic and Franklinic Currents on Nervous Tissue," was the subject of an able paper by Walter F. Cowl, of Berlin, Germany, which, in Mr. Cowl's absence, was read by J. G. O'Connor, M. D.

"Electricity in Aural Diseases," by Henry C. Houghton, M. D., of New York. The action of a current of electricity in the ascending or descending direction and the effects produced at the point of entrance to or exit from the body determine the question of therapeutics. An eustachian electrode was devised by the author and consisted of an eustachian catheter through which was passed a wire which ended in a spherical tip at the small lumen; the

wire was secured by a thread and met at the larger end in which a tip could be placed connecting with the rheotome and battery. In place of the speculum formerly used is an electrode made with a central wire terminating in a small spherical point over which a sponge or charpie could be drawn and secured by a small piece of hard rubber tubing varying in size according to the calibre of the external meatus; this, dipped in a weak saline solution and introduced well into the auditory canal, concentrates the current without the annoyances and dangers of maceration of old scar tissues to which one is liable in the use of hot water. For bringing within the circuit the tissues of the lower pharynx and anterior and posterior muscular structures, a tongue spatula, with insulated shank, is connected with the ordinary universal handle. A spatula electrode having a platinum surface superiorly and a porcelain surface inferiorly, and bent at straight angles to the stem so that it can be pressed against the posterior part of the hard palate, is now used.

A paper on "A New Method of Treatment for Gouty Arthritis of the Fingers," by Frank A. Gardner, M. D., of Washington, D. C., described an electrode for this purpose consisting of a glass vessel, about six inches square and four inches deep, filled with potter's clay. At its bottom is a metallic plate attached to a binding post on the outside. He attaches a large clay or felt electrode about 8 inches square to the positive pole and applies it between the shoulders, and the negative pole is connected with the binding post of the new electrode. The fingers are buried in the clay so as to cover all the joints involved and a current of from 20 to 50 milliamperes is passed for fifteen minutes, if agreeable to the patient. The strength is gradually increased at each sitting until 45 milliamperes can be borne for fifteen minutes.

"Inter-Uterine Cataphoresis," by W. H. King, M. D., of New York, was a paper which invoked a good deal of discussion; in it the doctor stated that the first instrument he used was a small platinum sound on which a small film of cotton was wound, and this carried the medicinal agent into the cervical canal. There were so many objections to this that he secured a staff of hard rubber tubing about 8 inches long; one end was split to connect with the rheophore, and on the other was screwed a hollow tube or receptacle for the medicament; through this tube runs a copper wire to within half an inch of the end, where a platinum wire is soldered to it, and this continues for one inch beyond the end of the shaft of tube and is thoroughly sealed to prevent the leakage of the medicine. A hollow sheath with longitudinal slits is screwed over the end. By a slight rotation of the electrode the whole surface of the membrane can be brought into contact with the opening of the sheath. There are three sizes of this sheath, so that one can be selected to completely fill the cervix or the body of the uterus. The cervix is dilated, if necessary, and the electrode dipped into the liquid to be used and the application made, the active electrode having been connected with the positive pole and the cathode placed on the abdomen, and a current of from 15 to 25 m-a is passed for from 8 to 10 minutes.

"Cicatrix and Stenosis of the Cervix Uteri Treated by Electricity," was the subject of a paper by Alice B. Condict, M. D., of Orange, N. J. The doctor removes the cicatrix by the application of the galvanic current; the cathode (aluminum) is applied to the cervix and a large positive pole upon the abdomen, and 15 milliamperes is passed for 10 minutes. Treatments are given twice a week and in about three weeks an improvement will be noticed. In two months the cervix, in a case she related, became normal in texture and had assumed a pink hue.

"A Case of Dysmenorrhœ" was considered by Bessie P. Haines, M. D., of St. Paul, Minn. The doctor uses the primary faradi current and regulates the intensity by the endurance of the patient.

A paper on "Important Points in Selecting Electro-Therapeutic Apparatus," by T. F. Livingston, M. D., of New York, advised against purchasing cheap wares. The faradic cell should be constructed for a given form of battery to operate. The coil should contain many thousand feet of wire so adjusted that the lines of magnetic force are cut in proportion to the selected form of battery to operate, thus utilizing the greatest possible amount of induction. The core or magnetic field requires careful adjusting, together with the primary cell. A perfect vibrating device should be secured and it should allow all possible adjustment as to unison of vibration and the magnetic field so constructed as to adjust the distance between the vibrating spring and the magnetic attractive piece, thus allowing for the increased or decreased electro-motive force as cells are added or removed from action. The platinum tipped screw making contact with the vibrator should be constructed so that it can be adjusted longitudinally along the vibrator and allow perfect adjustment. The screw point should be made with a view to reduce sparking, thus avoiding the oxidation of contact. The contact posts must not allow dust to settle to interfere with contact. There should be as few switches as possible, the contact pins should be arranged on top of the base, and switches so constructed that they can be readily removed by the operator. All contact parts should be perfectly soldered. A small apparatus should not be bought as the necessary parts are not included. In a galvanic battery there should be fair-sized plates, ready means of current manipulation, a simple device for immersing the plates in the fluid, a hydrostat that will allow the plates to be easily immersed; a device for electing cells singly, without shock; a pole changer and an interrupter. The cups should be either of rubber or glass and of good size.

In a "Report of Clinical Cases," Mr. Bonner Flinn, M. D., of Worcester, Mass., described a number of cases where electricity had been applied as a treatment with entire success.

In a paper on "Electricity as a Therapeutic Agent,' by W. S. Watson, M. D., of Fishkill, N. Y., the belief is expressed that electricity is of great value in nervous diseases, and that if such cases were treated in season much insanity would be avoided. Slight maniacal excitement, melancholia, and hypochondria are curable by modern methods aided by electro-therapeutics. The doctor thought that insane asylums should be completely equipped with electro therapeutic apparatus.

"Researches on the Action of Galvanic, Faradic and Franklinic Currents on Nerve Tissues," was the title of a paper by Walter Y. Cowl, of Berlin. The difference between galvanic, faradic and Franklinic currents was shown and illustrated by analogies decribing the various effects of these different currents on nerve tissue and the following conclusions were reached: 1. That, when of the same maximum intensity, a relatively gradual rise, as in the faradic closure current, produces much less effect than an instantaneous one. 2. That the faradic, like the momentary galvanic current, produces nervous incitation only by its rise and not by its fall. 3. That down to a very short period of excitation—in the present researches one-thousandth of a second—a difference in the amount of incitation, effected by an instantaneously arising current, varies only with the intensity and not with the quantity of electricity employed. 4. That, in contradistinction to the Franklinic current of enormous intensity and almost infinitesimal duration, both the faradic and the galvanic current of moderate intensity and decidedly greater, yet very minute duration, will produce no appreciable excitation, instead of an energetic response.

"An Apparatus for the Application of Heated Oxygen, or Ozonized Oxygen by Electrical Propulsion," was described by Irving Townsend, M. D., of New York. This is an attachment to the G. B. Underwood inhaler, and consists of an Edison Lalande battery of three cells, which decomposes a current of pure oxygen gas into ozone, and at the same time a second circuit, by means of a small motor, runs a small fan and thus keeps up a current of air and ozonized oxygen, mixed in any desired proportion, and which is forced through the heated cylinder of the inhaler. The apparatus consists of the inhaler, a cylinder of pure oxygen gas, the ozonizer, a small motor, a fan and the Edison battery.

A paper on "The Value of the Galvanic Crurent of High Amperage in Diseases of the Liver and Splen," by Lorenzo J. Kohnstamn, M. .D, of N. Y., gives the result of investigations as follows; That the direct action of the galvanic current upon the red blood cells is on of the nutrition, and that it improves the condiion of the blood dises, increasing their color and lessening the amount of the small sized dises. There is a two-fold action of the galvanic current—an elctrolytic acion, from which direct disintegration and separation of organized tissues occurs, and a galvano-chemical action, the results of which follow from by the action of acids or alkalies at either pole. Of the various forms of electricity the galavnic current is the only one which is of positive value in the treatment of diseases of the liver; galvanism of low ampherage is valueless, while the high ampherage cannot be used on account of its strong local caustic action; the galvano-interrupted current of high ampherage is the only one indicated, and, in the absorption of exudates or in stimulation of a gland, hyperaemic in action or passive state, it is the galvano-chemical action of the current which brings about the desired result.

A paper on "Electrical Massage in the Treatment of Diseases of the Ear," read by Thomas L. Shearer, M. B., C. M., of Baltimore, recommends that treatment in acute inflammatory conditions about the ear or where marked pain is present; but too sudden impact of vibrations, when very coarse and loud, will produce a marked degree of nervous shock in people of nervous temperament. Treatments should begin with sittings of ten minutes—two minutes with the slowest vibrations, three minutes with the

medium and five with the fast vibrations, taking care to test the susceptibility of the patient and proceed slowly, and not to prolong the massage in most cases over twenty minutes. In proper cases the patient says after treatment that there was a sensation as if air had been blown through the head from ear to ear. The best results are obtained where a moderate catarrhal condition of the eustachian tube exists.

It was resolved that the society hold its next annual meeting at Boston in September, 1895, and that the exact date and hall be left to the discretion of the Executive Board.

The officers elected for the ensuing year are as follows:

President, William L. Jackson, M. D., Boston; first vice-president, E. S. Bailey, M. D., Chicago; second vice-president, Frank A. Gardner, M.. D., Washington, D. C.; secretary, Clara E. Gary, M. D., Boston; treasurer, J. B. Garrison, M. D., of New York; executive board, the officers of the society and William H. King, M. D., of New York, and M. D. Youngman, M. D., of Atlantic City, N. J.

American Electro-Therapeutic Association.

The Fourth Annual Meeting of the American Electro-Therapeutic Association was held last week in the New York Academy of Medicine. The session lasted three days, September 25th, 26th and 27th, and the programme consisted of the reading ot scientific papers bearing upon the application of electricity to medicine.

The president's address—"The Function of the American Electro-Therapeutic Association"—was read by Dr. W. J. Herdman, of Ann Arbor, Mich. He spoke of the remarkable activity and interest that seems to have been awakened in all that relates to electro-therapeutics since the organization of the association a few years ago, and gave a brief historical outline of its work; he then stated the various needs of the Association, and also spoke of the necessity of having a cosmopolitan language in electrical science. "Words must mean the same to the electro-therapeutist that they do to the physicist. For the sake of simplicity, clearness, and in the interests of progress, the electro therapeutist must be willing to lay aside his 'galvanism' and 'faradism' and speak of constant and induced currents, while the physicist, electrical engineer, and biologist on the other hand must not affect a system of peculiarly technical expressions."

Following the president's address came the reports of committees on scientific questions. The report on standard meters, read by Dr. Margaret A. Cleaves, of New York, will especially interest manufacturers because of its conclusions. They were as follows:—

"(1) Meters should be recalibrated once a year. (2) Be constructed to record milliamperes on one scale to a predetermined point and high currents on a second scale. (3) Be ordinarily required to record up to 100 milliamperes. (4) Be placed in the horizontal position. (5) Be flexibly suspended from an isolated support. (6) Be reinforced by a mirror to assist in reading the scale. (7) Be provided with magnetic shade shields when not made with strong permanent magnets. (8) Be capable of indicating either direction of the current, though measuring it in only one direction. (9) Be furnished with reliable binding posts, shunt switches, etc.

Dr. Wm. J. Morton made a report for the Committee on Standard Coils and on Standard Electro-Static or Influence Machines.

Dr. W. J. Herdman, of Ann Arbor, Mich. read a paper on "Constant Current Generators and Controllers." He was followed by Dr. A. Lapthorn Smith, who discussed "Standard Electrodes."

Dr. Cleaves, in a paper on "The Electric Light as a Therapeutic and Diagnostic Agent," said that the electric light has come to do many things for the phsyician as a therapeutic agent. By its use he is able to light up the ear, nose, throat, and other cavities of the body so as to materially assist him in diagnosing or treating cases. The armamentarium of the electric light in therapeutics is already quite a large catalogue. Various devices have been brought forward by the electrical instrument maker and a description of these forms part of this paper. The reader spoke of the great difficulty in getting hold of the proper lamps for experimental work, the society's committee having, after a diligent search, only succeeded in getting a few lamps in order to try some experiments that were suggested. She also referred to the effects of sunlight and electric light on organic life, and spoke of the use of electric heating apparatus as especially adapted to meet the wants of invalids. Plants have been forced into rapid growth by exposure to the rays of the electric light, and d'Arsonval, in a recent study of the subject, observed that the coloration of bacterial growth was markedly influenced by the electric light. It has recently been obserevd that substances which have been submitted to the action of electricity, or which have been exposed to the direct rays of the sun, are in a peculiar state of excitement which renders them much more active as regards one another than are the same substances prepared by the ordinary methods of the laboratory.

One case was cited, of a stenographer suffering from anemia and aneurisis, who had been materially benefited by an electric arc light bath which was administered for twenty minutes. Dr. Cleaves spoke of the similarity of the effects of sunlight and electric light, and instanced the performances of Nikola Tesla to verify her statements.

Dr. Lucy Hall Brown read a paper on the "Sinusoidal Current Method of Regulating, and the Resulting Current." She also gave a description of some electrodes and exhibited a stand for administering static electricity. Dr. Margaret A. Cleaves exhibited a rheostat for controlling the static induced current. Dr. Robert Newman exhibited a portable battery for electric illumination.

The afternoon session was taken up with a discussion of the constant current. "Direct Current Distribution" was the name of the first paper, read by Mr. W. J. Jenks, of New York. It was an exposition of the effects of direct current distribution upon the human body. The reader took for his text various cases which had come under his observation and the cases of men who have been electrocuted.

Prof. A. E. Dolbear, of Tuft's College, read a paper on "The Physiological Effects of the Constant Current." Prof. Dolbear gave a general exposition of the features of the subject and then touched upon it from the therapeutic standpoint. Concluding his paper he said that since it has been practically demonstrated that what we call a glow lamp is a set of ether waves of electromagnetic origin, it has been apparent to some, although others have not seen the significance of the words, that all atoms are magnets, so that all give electromagnetic waves. Hence, from this assumption, it follows that the living body is but a combination of an enormous number of atomic magnets. It was long ago shown by Faraday that electrical and chemical changes were quantitatively equivalent, and now it is seen that electro-magnetism underlies all chemical action. The significance of it here lies in the thought that in working with electricity to effect physiological changes one is really at work with the fundamental factor of physiological energy, not in a roundabout way but in the most direct way. Functions of all sorts are electromagnetic in the last analysis and he who understands these and the art of properly applying electromagnetic energy to languishing or diseased organs will be able to do all that human skill can do. The more he studied the relation of life to the things on which it depends, the more he is persuaded that though death may be for the benefit of the race it is not necessary for the individual.

"The Therapeutic uses of the Galvanic Current" were discussed by Dr. A. D. Rockwell, and Dr. G. Belton Massey followed with a paper on "The Galvanic Current in Catarrhal Affections." Then came a paper by Dr. Georges Apostolli of Paris, entitled "The Ultimate Result of Conservative Electrical Treatment in Gynæcology," translated by Dr. A. Vedin. Dr. Robert Newman made a report on "The Electric Illumination of Caorities." "Most of the instruments that are used for electrically lighting the human body need improvement" he said. Lieter's cystoscope and the Desmormeaux endoscope he had used with great satisfaction. "The Behavior of Cancer under Mild Galvanic Currents," was the title of a paper read by Dr. R. J. Nunn of Savannah, Ga.

Prof. E. J. Houston and A. E. Kennelly, submitted a paper on "Some Experiments on Death by the Alternating Current." The paper was a protest against the conclusions which d'Arsonval of France has reached regarding the possibilities of the revivification of a person who has been brought under the supposed fatal influence of the alternating current. They endorsed his suggestion that a person shocked by electricity should be treated as a person drowned, but they emphatically call in question the correctness of d'Arsonval's general conclusions in the matter. The particular case mentioned by d'Arsonval contained no marked lesions or evident destruction of tissues, the death was only apparent and resuscitation under the circumstances of course possible. The fact mentioned by d'Arsonval that a pressure of 4,500 volts was on while the subject was shocked, Messrs. Houston and Kennelly think has no significance in the matter unless it is taken in connection with the current passing through the subject under that pressure. "A marked difference exists between the cases of the application of the alternating current as employed in electrocution in New York State, where the current is deliberately continued through the body for the purpose of killing, and such cases of accidental contact as that referred to by d'Arsonval. Assuming the correctness of the ammeter's reading quoted, that is, that a current of only 0.75 was passing, the resist-

ance of the body could not have been less than 6,000 ohms, and the resistance of the body with the electrodes used in the electrocutions in New York, i. e., one on the head and the other on the right calf, is sometimes as low as 200 ohms and usually not more than 300 ohms. The current strength employed is from five to eight amperes, say, from seven to ten times stronger than stated to have passed in the case mentioned.''

The writers then detailed a series of experiments in this line which they carried out with the help of some colleagues on a number of dogs in their Philadelphia laboratory. In the case of the dogs it was the unanimous opinion of several medical men present that the death was absolute and restoration impossible in three cases. They believe that the following conclusions may be drawn as the result of these experiments: First; that the passage of a sufficiently powerful alternating current through the body is followed by instantaneous, painless and absolute death. Second; That consequently where electrocution is properly carried out there is no possibility of the resuscitation of the criminal. Third; that in cases of accidental contact where the current passing is not excessive, it is quite possible that death may be apparent only and that the method of artificial respiration suggested by d'Arsonval should be followed.

There was no evening session the first day, the members of the Association attending instead a reception tendered to them by Mr. Nikola Tesla at his laboratory. Mr. Tesla provided a very suitable entertainment by exhibiting some theatrical feats with high frequency currents. A very enjoyable evening was spent by the members.

The second day's programme commenced with the reading of a paper entitled ''The Action of Electricity on the Sympathetic'' by Dr. A. D. Rockwell. Dr. Rockwell cited various cases to substantiate his remarks.

A paper on ''Metallic Electrolysis or Interstitial Electrolysis'' was read by Dr. Georges Gauthier. Interstitial electrolysis is accomplished each time we connect the positive pole of a pile of a gramme, Siemens other dynamo with an assailable electrode made in zinc, manganese, iron, aluminum, etc., or when we decompose a solution of potassium iodide. It is a voltaic application that was shown in electro-therapeutics by several workers.

This was followed by a paper on ''Electro-Therapeutics as Applied to the Eye'' read by Dr. L. A. W. Alleman, Brooklyn, N. Y. The paper concerned the treatment of opthalmic surgery and discussed the therapeutic value of the treatment of the eye by electricity. All the apparatus that is needed for the treatment of the eye in ordinary cases would be a battery of eight or ten cells, a milliampere metre and an electrolysis needle, the battery of course to include a rheostat or any other means of control that the maker may see fit to add to it.

Two papers, one on ''Secondary Peripheral Neuritis in a Stilt-Walker,'' and another on ''Electrical Reactions of Muscle and Nerves after Great Exertions in Sport,'' by Prof. J. Bergourie, of Bordeaux, France, followed. ''Notes on Goitre and the Improvements in the Apparatus for the Treatment of Same,'' was read by Chas. R. Dickson. Speaking of the treatment of goitre by electricity in the hands of the general practitioner, the author said that the possession of proper apparatus and its care, minute acquaintance with fundamental laws, and a proper estimation of the tremendous force of the agent employed, are only a few of the features which militate against the use of electricity in the treatment of goitre, and unless in the most exceptional cases it would be better to leave it severely alone.

The afternoon session was opened by ''Electric Sanitation'' by Dr. John S. Langley. ''The Physics of the Electric Light in Relation to Organized Matter'' was next on the programme, followed by a paper on ''Hydro-Electric Methods'' by Mr. Newman Lawrence, of London. Dr. Margaret A. Cleaves followed with a paper in the same strain on ''Special Hydro-Electric Applications.'' Then came Dr. W. S. Hedley, of Brighton, England, who sent a paper entitled ''The Hydro-Electric Therapeutics of the Constant Current.'' The author chiefly concerned himself with the electric water bath. Directions for treatment were given and the paper concluded with a description of the dimensions and construction of an electrical tub, which he has found very useful in practice. The bath tub should be of oak, ovoid in shape, about four feet ten inches long and two feet six inches in greatest width, which is two inches nearer the head than the foot. There are five fixed electrodes of bright metal covered only by light, open wooden framework. In addition to these there is an electrode for monopolar work consisting of a removable metal rod one inch in diameter, covered by wash leather. This is fixed across the widest part of the bath tub and can be conveniently grasped by the hands. The electrodes are connected by carefully insulated wires with seven terminals, and these in turn lead to a switchboard so arranged that by the insertion of plugs any or all can be brought into action either as anodes or cathodes. The connection with the battery coil of either source of supply is by well insulated connections leading to two ordinary binding posts on the plug switchboard. In the interests of cleanliness the electrodes should be of bright metal, as the neglect of cleanliness is often attended with serious results. Another electrode, is known as the ''paddle,'' which, by means of a long insulated handle can be applied to the vicinity of any part of the body upon which it may be desirable to concentrate the current. The device of placing a partition diaphragm across the bath tub through which the immersed body passes is worthy of trial. It must, in an important degree, influence current diffusion, and if further investigation prove its usefulness it ought to become in the future part of the standard electric water bath.

Prof. Elihu Thomson contributed some ''Notes on the Effects of High Frequency Discharges Passed Through the Body.'' Prof. Thomson said he had been experimenting with alternating currents for a number of years. His early efforts in this direction are contemporaneous with those of d'Arsonval and Tesla. He said that much absurd talk had been made in the newspapers over the ability of persons to withstand hundreds and thousands or even millions of volts. ''It is a very old experiment, of course, to insulate a person's body and charge and discharge the same with spark ten inches in length without special inconvenience. A person could be subjected to a charge or discharge at a high frequency, say of 10,000 per second, and with a voltage of 100,000 or 200,000, and yet have a comparative absence of sensation during the reception and reversal of charges.'' Prof. Thomson stated that he has ''never been satisfied with the vague explanations attributing immunity to the skin effects or the flow of high frequency discharges almost wholly on the surface of the conductor instead of through its interior. On the contrary the very nature of the tissues of the body would prevent the skin effect. The outside surface of the arm is fairly dry epidermis which on account of its high resistance would prevent the passage of current and the true dermal layer, though conducting, is of extreme sensibility, so that a concentration of current in the skin should rather enhance pain than annul it. That no condenser effect as such is the cause of the immunity, is proved by the simple consideration that two persons may have each an arm connected respectively to the electrodes of the high frequency apparatus, while if an incandescent lamp is held between them by the other hands so as to complete the circuit of which the lamp is a part, the lamp is lighted, though the actual potential of the source may be so low as to give a circuit having no more than $\frac{1}{32}$th of an inch. The position of the lamp in the circuit forbids condenser action if the potential itself were not too low for such action.''

The last paper of the second day was ''Some Landmarks in Electro-therapeutics,'' by Dr. O. S. Phelps, of New York. It was a resume of the advance of electro-therapeutics made in recent years. The immense amount of ground which has been covered while electricity has been passing from the hands of quacks into the hands of the scientist, was gone over by the reader of the paper.

The evening of the second day was devoted to a reception given at the New York Academy of Medicine to the Association by the resident Fellows.

The last day's session was inaugurated by a business meeting, after which ''Induction Currents'' were discussed. Dr. W. J. Engleman, of St. Louis, took care of the physiological end of the question. Dr. A. D. Rockwell talked on general faradization, while Drs. A. H. Goelet, H. E. Hayd and A. Lapthorn Smith treated the subject from the gynæcological standpoint.

The sinusoidal current was then taken into consideration. Mr. A. E. Kennelly went into the scientific delineation of what the sinusoidal current is. It is a ''particular kind of alternating current of which there are countless varieties. It takes its name from the fact that the current strength follows the law of sines as regards its variation in time. The term is synonymous with the term simple harmonic current. Simple harmonic motion is a constant occurrence in mechanics, being met with in fly wheels and engines of nearly every description. Of all possible types of alternating currents the sinusoidal current is the one which has the least mean rate of change and therefore of all possible alternating currents that can be applied to the human body it is the one which possesses, for the frequency considered, the least mean irregularity.''

The therapeutic effects of the sinusoidal current were then discussed by Drs. Herdman and Kellogg. The therapeutic uses of it were treated by Drs. Cleaves, Morton, Kellogg, Walker and Goelet.

Then followed a paper on "Alternating Currents; their Transformation and Therapeutic Application," by Drs. Gauthier and Larat of Paris.

Prof. E. J. Houston opened the last afternoon session with a paper on "The Functions of the So-called Static Induced Current." Prof. Houston talked on the static induced current from all standpoints, illustrating his arguments by drawings. He deduced the following practical points of interest. First: The most harmful discharges are obtained when the E. M. F. is high, that is, when the discharging balls are farthest apart; we have seen that this does not alter the frequency but increases the amplitude of oscillations of E. M. F., and therefore the amplitude of current in the circuit, other things being equal. It may happen, however, that the frequency of the sparks at a large air gap may not compensate for the increased current. Second: All unnecessary electrical resistances in the circuit should be eliminated in order to produce the maximum number of oscillations, and such coils employed in order to avoid unnecessary inductance and its depressing effect upon the frequency, should be in the form of loops and not spirals. Third: Where high frequency oscillations are desired, the condenser or condensers in circuit must be small and the inductance small. Fourth: High frequency can therefore only be obtained at the expense of total charge and discharge, for a small condenser will obviously hold less charge than a large condenser at the same E. M. F."

Dr. W. J. Morton then discussed the physiological effects and general therapeutic uses of the current, after which Dr. D. R. Brower, of Chicago, read a paper on "Some Observations on the Use of Static Electricity in the Treatment of Chorea." Dr. Margaret A. Cleaves then talked on the static induced current, and Dr. J. H. Kellogg, of Battle Creek, Mich., ended the session by a paper on "High Frequency Currents Derived from Static Machines as per Method of d'Arsonval."

Friday morning was taken up with a visit to the Edison Laboratory at Llewllyn Park, where the members of the association were entertained by the great scientist.

The officers for the coming year are: President, A. Lapthorn Smith, M. D., Montreal; 1st Vice-President, J. H. Kellogg, M.D., Battle Creek, Mich.; 2nd Vice-President, Chas. R. Dickson, M. D., Toronto, Ont.; Secretary, Emil Henel, M.D., New York; Treasurer, R. J. Nunn, M.D., Savannah, Ga. The next meeting of the association will be held in Toronto, September 1885.

Medical Electrical Nomenclature.

In the September number of the New York "Polyclinic" Messrs. Houston and Kennelly criticise the classification of currents usually employed by medical writers, and based upon former ideas in regard to different varieties of electrical fluids.

The classification now generally made of electric currents as employed for therapeutic purposes, is as follows: 1.—Faradic currents. 2.—Galvanic currents. 3—Galvano-Faradic currents. 4.—Franklinic currents. 5.—Static induced currents. 6.—The static breeze.

The principal objection against the preceding classification of currents as generally employed in electro-therapeutics, lies in the attempt to characterize the current by the source which produces it. This would only be warranted if the electricity produced by any particular apparatus was exclusively generated by that apparatus. As based upon more rational grounds, Messrs. Houston and Kennelly offer the following classification to replace the one referred to:

Continuous currents	Uniform (1)		(Galvanic).
	Pulsatory (2)		(Some varieties of Galvano-Faradic).
Alternating currents	Symmetrical	Sinusoidal (3).	
		Non-sinusoidal (4).	
	Dis-symmetrical (5)		(Faradic).
Intermittent currents	Oscillatory (6)		(Static induced).
	Non-oscillatory (7)		(Franklinic).
Convective currents (8)			(Static breeze).

Here it will be observed that all the different varieties of currents

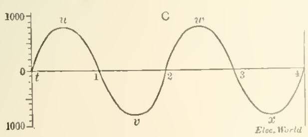


Fig. 2.—Diagram of Sinusoidal Alternating E. M. F's Capable of Producing a Sinusoidal Alternating Current.

are included under the four main classes of Continuous, Alternating, Intermittent and Convective.

Continuous currents may be uniform or pulsatory. A uniform current is produced by the action of a uniform E. M. F. as that of

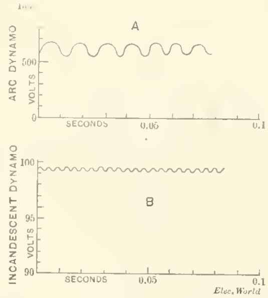


Fig. 1.—Diagrams of Pulsatory Continuous E. M. F's Capable of Producing Pulsatory Continuous Currents.

a Leclanche cell or of a thermo couple. Such E. M. F.'s as these would send a uniform current through the human body which corresponds to the galvanic current of the ordinary classification.

The pulsatory current is a variety of continuous current, which,

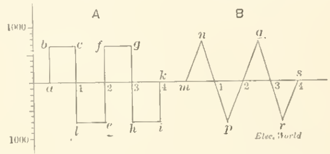


Fig. 3.—Diagram of Non-Sinusoidal Alternating E. M. F's Capable of Producing Non-Sinusoidal Alternating Currents.

although always flowing in the same direction, is not uniform in strength. The E. M. F.'s of most continuous current dynamos are of this type. Diagrams of pulsatory E. M. F. are shown in Fig. 1, representing the E. M. F.'s produced by arc and incandes-

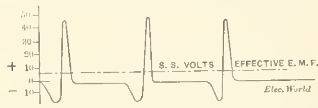


Fig. 4.—Diagram of Dissymmetrical Alternating E. M. F. Produced by a Faradic Coil, Capable of Producing a Dissymmetrical Alternating Current.

cent dynamos, the pulsations being more marked in the former than in the latter cases. Such pulsatory E. M. F.'s applied to the body would produce pulsatory currents.

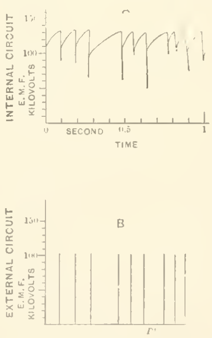


Fig. 5.—Diagram of Intermittent E. M. F. as Produced by Frictional or Influence Machines, and Capable of Producing Either Oscillatory or Non-Oscillatory Intermittent Currents according to the Nature of the Discharging Circuits.

Alternating currents, i. e., currents which periodically reverse their direction, may be either symmetrical, or dis-symmetrical.

Symmetrical alternating currents may be sinusoidal or non-sinusoidal. Fig. 2 shows a diagram of a sinusoidal alternating E. M. F., capable of producing a similar type of current. Fig. 3 shows a similar diagram of non-sinusoidal alternating E. M. F. Voltaic alternating currents are of this type.

The dis-symmetrical alternating current is the type of current produced by all faradic coils under the influence of vibrating contact breaker. Fig. 4 is a diagram of such an E. M. F.

Intermittent currents may be oscillatory or non-oscillatory. An oscillatory current is an alternating current, usually sinusoidal in type, but decaying in amplitude, each wave being of smaller amplitude than the preceding. Oscillatory currents, produced by the discharge of a Leyden jar, correspond to the static-induced currents; they are usually of extremely brief duration, and of very high frequency, a whole series, of perhaps ten oscillations, being completed, in, say, the twenty-thousandth part of a second.

Non-oscillatory intermittent currents are produced by discharges from influence machines through circuits unfavorable to the development of oscillations. E. M. F.'s capable of producing intermittent currents are shown diagramatically in Fig. 5. Franklinic currents are of the non-oscillatory intermittent type.

The convective current, or convective discharge, is produced by the convection of electrified particles of air or other material. To this type belongs the static-breeze.

Notes on the Management of Railway Power Stations.—I.

BY GEORGE T. HANCHETT.

THE BOILER.

As an engineering analogy to the old saying "Charity begins at home" we might say economy begins in the boiler room. We have a poor start in generation of electricity from coal. Thomson has given the law of degradation of energy by saying that, "All energy tends to pass from a higher form to a lower and ultimately to assure the form of uniformly diffused heat." Starting as we do with the very lowest form of energy it is only by the careful effort on the part of man that we shall succeed in raising a goodly percentage of it to that highest form, electrical energy. Heat is the most elusive of all forms of energy to direct and control, and therefore the successful, practical station manager must know how to handle his boiler.

The aim of this series of articles is not to furnish a universal fund of information for the management of power plants, but it is rather to discuss some points of interest, and some practical difficulties which arise, together with hints and remedies which the writer has found useful.

Very few people realize how much coal is wasted by boiler scale. Below is given a table which in a very general way shows the loss of fuel from various thicknesses of scale. It is to be borne in mind, however, that there are many different kinds of scale, and that their heat conducting powers vary very widely.

Thickness of scale in inches.	Loss of fuel in per cent.
1-64	2
1-32	4
1-16	9
1-8	18
3-16	27
1-4	38
3-8	48
1-2	60
5-8	74
3-4	90

From the above it may be seen that even a small thickness of scale is a serious matter, and where the amount of coal used is large the saving would represent so great an interest that it would pay to invest a large principal to avoid the scale. Boiler scale, like everything else, must be battled with systematically. Potatoes or tan bark will not cure your boiler from scaling just because some one else has used them with great success. Boiler scales are different in their nature and chemical composition and a remedy which would be valuable in one case will be worthless or even detrimental in another. There are only a few general rules, which apply in almost every case, and which tend to avoid any kind of scale, and these will be given subsequently.

Boiler scale may be divided into four classes. That which results from

(1) Solid matter held in suspension in the feed water.

(2) Mineral salts soluble in cold water, but not in hot.

(3) Mineral salts soluble in water charged with carbonic acid. This gas is driven off by heat and the salts precipitate.

(4) Mineral salts soluble in both hot and cold water.

The remedies may be applied

1. Before the water enters the boiler.
2. After the water enters the boiler.

The first of these methods is preferable as there is then no chance for a boiler to scale on pure feed water.

Treatment of case (1). Filtering and allowing to stand till the sediment settles is the best method. The water may possibly be treated with chemicals and the case reduced to that of case 4.

Treatment of cases (2) and (3). Use hot feed water and allow it to stand in a settling drum. Neglect of the second caution is the usual cause of scale, as no one uses cold feed water. The aim should be to precipitate the foreign matter as a soft mud in the settling drum where it can be easily removed and not allow it to bake into a hard scale on the boiler, where it requires for its removal a hammer and cold chisel.

For case 4 there is no excuse. The general rules given beyond will entirely prevent it. If the writer had not actually seen such cases and found incrustations of soluble salts in some few neglected boilers he would hesitate before classing this as a source of scale.

The use of chemicals to prevent boiler scale is much misunderstood. Briefly it should be governed as follows: Chemicals should be used before the water enters the boiler with the idea of precipitating all the matter in solution or suspension as a soft mud, as before explained.

After the water has entered the boiler the aim should be exactly the reverse. The chemicals should either unite with the salts and produce a salt that is soluble, and thus reduce to case four, or they should form a flocculent precipitate with the salts that will be held in suspension and not adhere to the sides of the boiler to bake into a hard scale. Care must be taken that the chemicals added are not injurious compounds in themselves or form injurious compounds with the salts in the feed water. It is, therefore, absolutely necessary to know what the composition of the scale is before applying chemicals as a remedy. Corrosion is a worse evil than scale.

Below is given a list of various chemicals and substances used in the prevention of boiler scale and comments on their action and their merits.

Caustic soda. This salt will absorb carbonic acid gas and will thus render the carbonates of lime and magnesia insoluble in the water previously charged with this gas. These latter salts often occur in boiler scale. Lime and carbonate of soda are also useful in this case. Any of these salts must be added in certain definite proportions according to the nature of the feed water and the amount of salt that it contains in solution. To treat water with caustic soda it must be at least of a temperature of 180 degrees F. and with carbonate of soda the water must be at the boiling point. These chemicals are to be used before the water enters the boiler, as they precipitate the obnoxious compounds. Care must be taken to let the precipitate settle or the trouble is made worse. Caustic soda or lime will usually do any work of this nature. Special boiler compounds are to be avoided. The very assumption that such a compound is a universal cure for boiler scale is a sufficient proof that it is worthless. These compounds are also liable to contain injurious substances.

Zinc when introduced into a boiler will sometimes prevent scale, particularly when the scale is sulphate of lime. It forms a precipitate which is held in suspension. It is not effective if the water contains much organic matter, and it must be used cautiously as in some cases it corrodes the boiler.

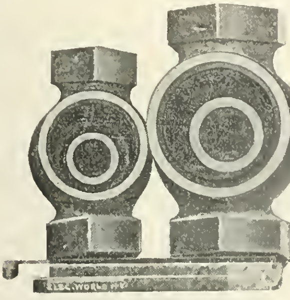
Oil: Too much caution cannot be used in the use of oil in boilers for the prevention of scale. The oil forms a thin coating on the plates and the scale does not adhere and bake on. It is, however, very liable to cause over-heating of the plates and will thus bulge them in a manner that will ruin the boiler. The oil used should be the highest grade of kerosene, and the use of an oil with a body or one that has lubricating properties is fatal to the boiler.

Vegetable substances may be sometimes used with success in cases of water containing salts of lime. They form a precipitate with the latter, which precipitate is held in suspension and does not deposit on the plates. Oak bark, tan bark, and chips are sometimes useful.

In general to avoid scale, heat the feed water and use the settling drum. This will prevent a great deal of foreign matter from entering the boiler. That which does succeed in entering may be reduced by frequent blowing off. If the boiler is blown down to the lower gage cock and then pumped up again the gain will be just the difference in the amounts of solid matter in the quantity of water

blown off and the same bulk of less saturated water pumped in. The boiler should be periodically cleaned out and started with fresh water.

Corrosion of boilers is a most annoying and dangerous evil. It may be either internal or external. Internal corrosion is usually caused by poor feed water or by some remedy(?) for boiler scale. External corrosion is often caused at the contact of the boiler with its setting by moisture on the destructive action of cement. Corrosion frequently results from leaks and the constant evaporation of water on the outside surface. The head of a rivet may be completely removed by corrosion. Boilers should be frequently inspected to detect such rivets. The injured riverts may be temporarily replaced by short bolts of the same size or nearly so, supplemented by heavy well-annealed copper washers. Lead washers may be used with advantage where the rivet holes in question are removed from the influence of fire. In placing such a bolt have the bolt hot and



GROOVED GLOBE VALVE SEATS.

the washer cold. This, together with the fact that copper expands more than iron with a given rise of temperature, will insure a tighter joint. A tight joint is very necessary, as a jet of escaping steam will cut grooves in the neighboring rivet heads, or, in fact, any metal that it strikes, and this in an incredibly short space of time. It will also enlarge the orifice from which it escapes and make matters worse. The cutting of steam valves is a familiar example of this phenomenon. The accompanying illustration shows two specimens of such valves. The necessity of shutting a steam valve tightly is there clearly shown.

Much has been written on "how to fire boilers," and much more might be written. Suffice it to say that no general rules apply to any one boiler. The draught, the type of boiler, and the kind of coal are important considerations. The necessity of a good fireman is most important. The writer will not attempt to enter into a wordy discussion on this matter, but will present the following calculation which will speak for itself. Let us assume coal worth $2.50 per ton and that the fireman has to stoke a 300-hp plant at full load ten hours daily. Assume also 300 working days to the year. A good fireman with a good plant will use three and one-half to four pounds of coal per horse power per hour and a poor fireman may use as high as six pounds. Assuming a saving of one and one-half pounds by the good fireman, the yearly saving is

$$\frac{1\tfrac{1}{2} \times 300 \times 300 \times 10 \times 2.50}{2,000} = \$1,687.50,$$

an amount sufficient to pay the increase in wages of the good fireman and have a snug sum to spare. The yearly coal bill, assuming a consmption of four pounds per horse power per hour, would be

$$\frac{4 \times 300 \times 300 \times 10 \times 2.50}{2,000} \text{ or } \$4,500.00.$$

Is there a capitalist who would seriously think of allowing a $1.50 per day man to invest $4,500.00 for him yearly? And yet that is precisely what some are doing. The coal is just as truly wealth even if it be as cumbersome as the iron money of Lycurgus.

(To be continued).

The Attractiveness of Alternating Current Distribution.

Our London contemporary, the "Electrician," which has not been the most friendly journal toward the alternating current systems, makes the following remark: "If the general public were allowed to become familiar with all the practical details of alternate current distribution, all the mystery, and, therefore, half the attractiveness of that system would be gone."

Electrodynamic Machinery—X.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

47. We will now proceed to study the phenomena which occur when iron is introduced into a magnetic circuit. Suppose, for example, a closed circular coil in Fig. 44. We have seen that if this ring be excited with 800 ampere turns, or 1005.6 gilberts, the flux through the ring will be 167.6 webers, or, since the cross section of the ring is ten square centimetres, the intensity will be $\frac{167.6}{10} = 16.76$ gausses, and this intensity would remain practically unchanged if the substance of the ring were copper, brass, lead, zinc, wood, glass, etc. When the ring is made of iron or steel, a very marked change takes place, the flux instead of being 167.6 webers, becomes, say 170,000 webers, with a corresponding increase in intensity. This increase of flux in the circuit must either be due to an increase in the M.M.F., or to a diminution in the reluctance. It is usual to consider that iron conducts magnetic flux better than air; or, in other words, has a greater permeability than air. This idea corresponds to a reduction of reluctance similar to the reduction of resistance in an electric circuit. Although generally accepted, this conception is manifestly incorrect; for if the increased flux due to the presence of iron in the ring disappeared immediately on the removal of the M.M.F., then there would be no preponderance of evidence in favor of either hypothesis. But the magnetic flux does not entirely disappear on the cessation of the prime M. M. F. On the contrary, in the case of a closed iron ring, the greater portion of the flux remains in the

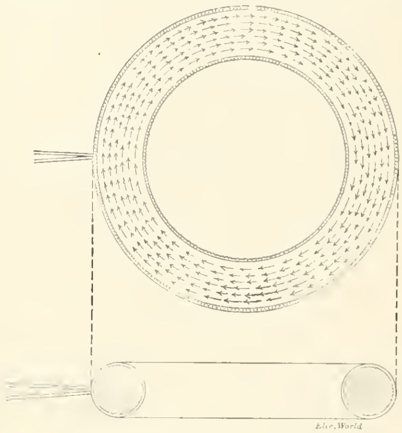


FIG. 44.—SECTIONS OF WOODEN RING UNIFORMALLY WRAPPED WITH INSULATED WIRE CARRYING A CURRENT.

form of what is ordinarily called *residual magnetism*.

48. It is evident, therefore, since the M.M.F. is necessary to maintain the residual magnetic flux in the iron, that this M.M.F. is the cause of the increase in magetnic flux when the prime M.M.F. is applied, and that, therefore, the increased flux cannot be due, except, perhaps, in a very small degree to a change in the reluctivity of the medium, but is due to the establishment of a M.M.F. in the iron itself under the influence of the magnetizing flux. It is now almost certain that the ultimate particles of the iron, possibly the molecules, or the atoms, are all initially magnets; i. e., inherently possess M.M.F.'s and magnetic circuits. The origin of this molecular magnetism in iron is, however, not yet known. In the natural condition, all the separate magnets of which iron is composed, are distributed indifferently in all directions, so that their circuits neutralize each other and produce no appreciable external effects. Under the influence of a magnetizing flux, these molecular magnets tend to become aligned, and to break up their original groupings. As they become aligned, and their M.M.F.'s become similarly directed, they are placed in series, and their effects are cumulative, so that they exercise an increasing external influence, and an extending external flux. Or, taking the hydraulic analogue already referred to, and regarding each separate molecular magnet as a minute ether pump, as all the ether pumps are brought into line, the streams they are able to direct are increased in velocity, and are, therefore, carried further into the surrounding space. Consequently the flux

produced in the magnetic ring shown in Fig. 44 when furnished with an iron core, may be regarded as arising from two distinct sources of M.M.F., namely:

(1) The prime M.M.F., or that due to the magnetizing current which produces the flux through the circuit and substance of the iron, the value of which is practically the same as though the core were of wood or other non-magnetic material. This flux may be called the prime flux and possesses a corresponding prime intensity. In the case considered the prime intensity or magnetizing flux is 16.76 gausses. This magnetic intensity, acting upon the molecules of the iron, produces:

(2) The induced M.M.F., which may be called the aligned or structural M.M.F., and depends for its magnitude not only upon the quality of the iron, but also upon the intensity of the prime flux. The harder the iron, and the greater its mechanical tendency to resist distortion, the greater must be the prime intensity or the magnetic distorting power, in order to bring about the full structural M.M.F. When the prime intensity has reached such a magnitude that all the separate molecular magnets in the iron are similarly aligned, the iron is said to be saturated, and the M.M.F. it produces is a maximum, and on the removal of the prime M.M.F. the structural M.M.F. will, in the case of a closed ring, largely remain, especially if the ring be of hard iron or steel. If, on the contrary, the ring be of soft iron, and have an air-gap cut in it, the structural M.M.F. may largely disappear. The relation between the structural M.M.F. and its flux, and the prime M.M.F. and the intensity which produces it, is complex and can only be ascertained by experimental observation.

49. Fig. 45 represents the same iron ring with a saw-cut or air-gap at A, having a width of 0.5 cm. The reluctance of this air-gap, which neglecting diffusion, has a length of 0.5 cm and a cross-section of 10 sq. cms. is $\frac{0.5}{10} = 0.05$ oersted. If the total structural M.M.F., established in the ring under excitation, be 180,000 gilberts, then immediately on the withdrawal of the prime M.M.F., the residual flux through the circuit will be $\frac{180{,}000}{6} = 30{,}000$ webers. Where this flux passes through the reluctance of the air-gap there will be established a *counter M. M. F.*, just as in the electric circuit where a current of I amperes passes through a resistance R there is established a *counter E. M. F.* of IR volts. So that the counter M.M.F.

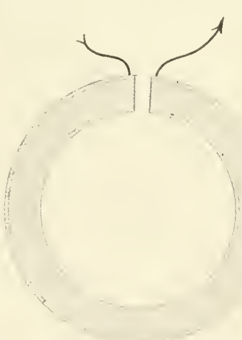


Fig. 45.—Iron Ring Provided with Air-gap, and Wound with Wire.

has in this case the value, $\mathcal{F} = \Phi\mathcal{R} = 30{,}000 \times 0.05 = 1{,}500$ gilberts. This counter M.M.F. represents a mean demagnetizing force of $\frac{1{,}500}{60} = 25$ gausses, through the iron circuit. If this intensity of demagnetizing force is sufficient to disrupt the structural alignment of the molecular magnets, the residual magnetism will disappear. If, however, the intensity be less than that which the hardness of the iron requires to break up its structure, the residual magnetism will be semi-permanent.

Even though it be admitted that the preceding represents the true condition of affairs, and though it is the only existing hypothesis by which the phenomena of residual magnetism can be accounted for, nevertheless, for practical computations connected with dynamo machinery, it is more convenient to assume that there is no structural M.M.F. in iron, and that the difference in the amount of flux produced in ferric circuits is a consequence of decreased reluctance in the iron, or, in other words, that iron is a better conductor of magnetism, and we will, therefore, in future, adopt the untrue but convenient hypothesis.

(To be continued).

How to Make a Voltmeter and Ammeter.—For Amateurs—II.

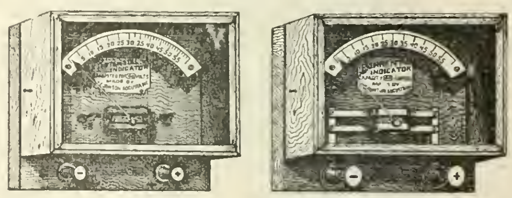
BY G. E. DUNTON.

We will bring the current in at the right hand binding post, as it will be more convenient, and the direction in which the needle will swing is given in Orestedt's law, which is as follows:

"A current of electricity, passing or flowing (so termed) in a wire, from left to right, over and back under, will cause a needle, suspended with its length in a plane with the direction of the current, to deflect or swing to the right, until it reaches a point at right angles to this plane, where it becomes set as long as the specific force of the current is maintained. A current flowing from right to left, over and back under, will cause the needle to swing to the left."

Bearing these facts in mind, we will begin to wind. A wooden arbor should be fitted to the hole through the core, and, with a dog on the face-plate end, placed between the lathe centres. The wire should be on a spool and placed over a spindle of some kind, so it will turn freely. Begin in the coil space next to the face plate, or at the left hand, put the end of the wire through the fibre plug in the inside collar, draw through three or four inches of the wire, coiling it around a common lead pencil into a tight helix to keep it out of the way. Now begin to wind slowly, turning the lathe backwards, which should be done by hand for a coil of this shape. As each layer is wound in, give it a good coat of insulac before the next is wound on over the top of it. The winding should end on the rear side next to the middle washer. Leave an end of about eight inches coiled into a helix. Tie it where it leaves the coil with fine thread to the next strand, this keeping it from unwinding. A little trick, which it may be worth while for the amateur to know, is as follows: Before the last layer or coil has been wound on, and when we have reached the last turn of the layer preceding it, cut the cotton-covered wire, splice on and solder some double silk-covered wire of the same size, letting the splice come on the rear side of the coil. Wrap a thickness of stiff brown paper around the coil and wind on the last layer over it

When the other coil is wound in, turn the arbor around, bringing



The Completed Instruments.

the coil space next to the face plate, and proceed in exactly the same manner; the inside ends coming through the fibre plugs should be scraped free of insulation, twisted together, soldered and the surplus end snipped off. The two outside ends go through the fibre posts in the back of the case, through the back, to their respective binding posts. The wire should be covered with soft rubber tubes and run in grooves cut in the under side of the back, from the fibre posts to the binding posts. In going from the core to the fibre posts, leave about a dozen turns of the helix in the end wire, opening it out some; this looks more finished than a straight length of wire would.

This instrument is wound for a potential not exceeding 60 volts. If desired to measure a higher potential, use a proportionately finer wire, or put in more resistance, as stated. Each coil space holds 22 layers of wires of 22 turns each, making 968 turns of wire in both coils. Before the ends are connected to the binding posts, the needles should be put in place, the spindle inserted, the pointer put on, the hangers screwed in place and the armature movement adjusted carefully, and the whole screwed to the back of the case, the scale being placed in position and nicely adjusted, so that the pointer will swing evenly over it. The markings on the scales had better be done in India ink, so that it can be readily changed if desired. It is a good plan to paint the needles, say the right hand half red and the left black, so that if ever taken out they will be returned in the same position. If you are fortunate in having some friend in a lighting station, and can secure his permission to put your meter on beside the station instruments, the calibration can be

easily and accurately done. The swing of the pointer may be governed by the size of the balance weight; if it doesn't swing quite far enough, trim off a little from the weight. All future adjustments should be with the thumb nut. The first adjustment should be made with the nut way out to the end of the screw. See section No. 4. If the builder desires, he may substitute two incandescent lamps in series for the German silver wire, and re ulate it by different voltage lamps. In a meter the writer has just completed two 59 volt lamps, in series, furnish the necessary resistance. The meter coils are in multiple or parallel, and there is not as much heat.

The winding of the ammeter is entirely different. For the winding, four strips of sheet copper are needed, 4 feet long, 7-16 of an inch wide and 1-64 thick. In insulating the core, use the same kind of leather-board washers, and also one of mica, placed between this and the brass collar on each end. Wrap a thickness of mica around the core, with one thickness of asbestos paper around this, and lay two thicknesses of the copper together; this will constitute a layer in winding. Mark off a point about 6 inches from the end and bend the ends over across the strip in the form of a square, as shown in Fig. 15A. Now carry the ends up by the side of the strips, Fig. 15B. The purpose of doing this will become apparent by laying the copper in position in the coil space; while the copper lies flat on the core, the end will come out by the succeeding layers to be laid on, fitting nicely into the recess pressed into the middle brass collar. After the copper has been carried once around the core, and before it is passed over itself, a strip of mica and asbestos paper must be carefully laid in and carried out between the succeeding layers as we continue to wind. A piece of the leather board and mica must be slipped in between the coil and the end coming out at the side.

The winding is carried in exactly the same direction as in the voltmeter. Both coils should end on the rear side, looking at the front; the finishing end of the upper coil will be on the right hand side, while that of the lower coil will be on the left. The beginning ends of the coils may be bent down and across their respective coils, and the ends again turned over themselves at right angles and coming out in the opposite direction from the finishing end of the respective coil. Great care must be used in insulating; wherever this end crosses the other layers and where it bends over the last layer the insulation must be perfect. This method of winding gives us two parallel circuits, having a safe carrying capacity for a current of 100 amperes, though the model is adjusted for only 60. Two copper bars, ½ inch wide, ¼ inch thick and about 6 inches long, are sunk into the back of the case, with asbestos paper between the metal and the wood. They are drilled and tapped for the screws holding the ends of the copper strips at their upper ends, while the lower ends carry the binding posts on the outside of the case. The needles, spindle and pointer may be put in place, the instrument set up and final connections made.

The builder will be fortunate indeed if he can find a chance to place this meter in circuit beside some standard ammeter and calibrate it, but the adjustment and calibration may be accomplished very nicely by using incandescent lamps of a known efficiency; knowing the watts per lamp and voltage, the current each one takes is readily calculated by the following simple formula: Watts ÷ voltage = the current. For the adjustment, turn on all the lamps the dynamo carries and adjust the weight so the pointer will swing as far over the scale as desired. In calibrating, turn them all off, and then turn on one at a time, noting and carefully marking each degree the pointer advances as the lamps are turned on. Try this several times, changing the order of turning on the lamps each time, and carefully note whether or not any variation occurs. If it does, provision must be made for it; if not, the scale may be nicely numbered and the meter is complete. This same core may be wound with wire for a small current, as in arc lighting, using double or triple cotton-covered No. 12 B. & S. gauge copper wire, with the two coils connected in series. The entire success of both these instruments depends wholly upon careful, painstaking construction. The ammeter is in series with the dynamo; that is, the whole current passes through its coils. The voltmeter is in parallel to, or in multiple with it, only a very small portion of the whole current therefore passing through its coils, but it receives the whole pressure of the current. In sending a current through the coils of either of these instruments for the first time, swing the pointer over as far as it goes to the right, *before* the current is turned on; hold it there for a few moments and let the current circulate through the coils; this insures correct polarity. Should the needles refuse to take the respective poles as we desire, take them off the spindle and reverse the ends.

The Convention of the American Street Railway Association.

The secretary of the American Street Railway Association officially announces that the thirteenth annual meeting of the Association will be held in Machinery Hall, Piedmont Park, Atlanta, Ga., October 17, 1894, commencing at 10 o'clock, A. M., and continuing three days. The following is a general programme of the meeting: Reports of special committees will be made on: "A Standard Form for Street-Railway Accounts;" "Can the T Rail be Satisfactorily Used in Paved Streets;" "City and Suburban Electric Railways;" "Mail, Express and Freight Service on Street Railway Cars;" Standards for Electric Street Railways;" "Street Car Wheels and Axles;" "The Best Method of Treating Accidents and Complaints;" "The T Rail Construction of the Terre Haute Street Railway Company," and "Transfers and Commutation." Special papers will be read on the following subjects: "A Practical System of Long Distance Electric Railway Work;" "Brake Shoes;" and "Destructive Arcing of 500 Volt Fuses."

An exhibition of supplies of every nature used in the street-railway business will be held in Machinery Hall. The building has been engaged for two entire weeks, beginning October 10th., and ending October 24th, thereby giving ample time for the setting up and removal of the largest exhibits. The exposition will be in charge of the Secretary, assisted by Mr. N. W. L. Brown, of the Atlanta Consolidated Street Railway Company. Applications for space, if not already made, should be sent without delay direct to Mr. Brown, at Atlanta.

The Atlanta Consolidated Street Railway Company proposes to entertain all who attend the meeting with an excursion. A typical "Georgia Barbecue" will be a prominent feature of the occasion. All the Traffic Associations, except the Western Passenger Association, have authorized the sale of tickets at a fare and one-third for the round trip. This concession applies to all attending the meeting—delegates, supply dealers and accompanying friends. The attendance of the wives and daughters of gentlemen attending the convention has become an established custom, and the ladies will be entertained Wednesday evening at the Capital City Club. The annual dinner will take place in Thursday evening, October 18. Each company that is a member is entitled to the tree admission to the banquet of two of its officers. Each additional officer, or any other gentleman in attendance at the meeting not an officer of a member-company, will be charged ten dollars; ladies tickets, will be five dollars each.

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—I have read with interest this week's addition to the somewhat fruitless discussion of the best form of wave in alternators. I regret that the accomplished Editor of the London *Electrician* should have had recourse to "secular polemics" in what should be purely a calm and scientific discussion.

As you may judge from my previous letter upon this subject, I am in substantial accord with him on the irrelevance of the extreme claims made for the sine wave by "the manufacturers in America" to whom he refers; nevertheless it seems to me that the discussion has degenerated into a squabble and has been full of mutual misunderstandings.

In the first place, there has been scanty recognition of the very wide difference in conditions when we consider static transformers and rotary field motors. What is true of the former is only true of the latter in so far as the induction motor may be regarded simply as a transformer without reference to its motor function. If Fourier's theorem means anything in relation to the question under discussion, it means that in the case of a non-sinusoidal wave we may consider it to be built up of a single fundamental wave plus a series of other sinusoidal waves. These latter, from physical reasons, we recognize as harmonics of odd order. When, therefore, we are dealing with a non-sinusoidal wave of a given frequency, we must recognize the fact that of the total energy of the wave a portion is at the virtual frequency F and other portions at frequencies $3F$, $5F$, etc. When such a wave is used in a transformer having an iron core, the effect is precisely the same as if we were dealing with a sinusoidal wave having a certain other frequency F greater than F. It is, therefore, to be anticipated that, providing the conditions are such that we can utilize these higher harmonics, transformation can be effected with a less core-loss. This only restates the familiar fact that with a transformer designed for a particular frequency, a greater output at substantially the same loss can be obtained by increasing the frequency within, of course, reasonable limits. There is not the slightest reason, either mathematical or practical, to suppose that in any given case any better results would be obtained

from using a wave consisting of an indefinite number of harmonics than from a sinusoidal one of equivalent frequency, as regards magnetization. As M. Blondel has very justly stated, the sinusoidal wave would have the advantage in the matter of convenience, because of the greater certainty with which static and inductive effects can be predicted.

The equivalent frequency f_e not being the same for all conditions of the external circuit, as M. Blondel suggests, there is an added convenience in employing the sine wave rather than a mixed one. So far as static tranformation goes, the non-sinusoidal wave is merely an indifferent method of raising frequency, possessing certain inconveniences and no particular compensating advantages; for as Mr. Steinmetz has very justly pointed out, it is quite easy to produce very close approximations to the sine wave in a properly designed iron clad alternator.

As regards induction motors the case is decidedly different. While the mere action of transformation accomplished in such motors will follow the same general rule above stated with reference to static transformers, it is quite certain that rotary poles of the higher orders are of little or no use in the operation of the motor, and the higher harmonics only tend to disturb the proper functions of the apparatus by increasing parasitic currents, adding to the inductance of both primary and secondary circuits and the like. In general, the worse the motor the more will these variations interfere with its proper action. If it is properly designed, its motor functions will be seriously disturbed only by quite great disturbing harmonics. This corresponds with the results found by both Mr. Steinmetz and myself.

It should be noted here that the case in which Mr. Steinmetz found 13 per cent. advantage in using a distorted wave was not, as the Editor of the *Electrician* states, in a motor, but in a static transformer, and furthermore, one of low frequency type, in which the saturation was comparatively high.

Going back to our idea of an equivalent frequency, we must recognize the fact that in motors the speed is determined by the fundamental; consequently when a widely non-sinusoidal wave is used, a portion of the energy is relatively ineffective, while with the sine wave of equivalent frequency, the speed of the motor would correspond with the total energy. Of the bad effects of non-sinusoidal wave in motors of this class there can be absolutely no question so far as the fact itself is concerned, as is amply shown by the experiments of the various parties to this discussion.

With various waves the energy represented by the harmonics may be more or less in effect, but can never be entirely helpful or quite unobjectionable. It is, however, sufficiently obvious that for moderate variations from the sine form and for well designed motors, the effect is negligible.

So far as the line is concerned, higher harmonics are bad in proportion to their amount. A wave containing them is worse than the sine wave of equivalent frequency in its static relations and with respect to resonance, in which of course the upper harmonics, if of appreciable amount, are particularly objectionable. Experimentally we cannot speak with the same certainty about a line as about an induction motor, but while small variations would probably prove to be more unobjectionable, large ones might be serious, and in any event are quite useless and unnecessary.

Chicago, Ill. LOUIS BELL.

The following letter by J. A. Fleming on the subject of the sine form of curves of alternating E. M. F. appeared in the London *Electrician* of September 7th:

I only lately became repossessed of my weekly copy of The *Electrician* and read the letters and editorials on the above subject. Broadly speaking, all the evidence I have before me, deduced from a very extensive series of tests on transformers, which have been made on different types of alternators grouped in various ways, leads to a conclusion which is identical with the position taken up by Mr. Steinmetz. If one and the same transformer is tested at the same mean-square primary pressure off alternators of different types, the iron loss in the transformer at no load is found to vary. Taking, for instance, a particular type of transformer, I found that when tested for iron loss on an alternator having a drum armature, with iron core of the type of Westinghouse or Thomson-Houston, the iron loss is less by some 10 per cent. than when tested on an alternator having a copper strip iron-less armature of the type of the Mordey or Ferranti armatures.

It must, however, be borne in mind that the form of the electromotive force curve of an alternator, when determined by an electrostatic voltmeter and contact breaker—the alternator being taken alone and on open-circuit—is not necessarily or always identical with the form of the curve of potential difference between the primary terminals of a transformer worked off that alternator. It is, of course, the form of this last curve which it is important to know. I find, also, that the power factor of a transformer at no load is less when the transformer is tested at the same mean-square primary pressure off an iron-clad or iron-cored armature of the drum-type, than when tested off a strip iron-less armature; but that the apparent power taken up in both cases is about the same. Coming, then, to one question at issue, viz., the form of electromotive force curve which the alternator should possess in order that the iron losses of transformers worked off it should be a minimum. This is a question which can only be settled by an experimental comparison of the no-load losses of transformers tested off alternators of which the E. M. F. curve is at the same time ascertained. Inorder to do this when the alternator is at a distant place, some means must be obtained of driving a revolving contact breaker at a definite speed relatively to the alternator. This, I find can be done by putting the contact breaker on the shaft of a small synchronizing alternate-current motor, which runs in step with the distant alternator, and enables the instantaneous curve of potential difference between the primary mains to be ascertained. By the employment of this device I expect to be able to place against one another the results of a series of tests in which the iron losses of the transformer are compared with the form of the curves of the primary potential difference applied to its terminals. Until these experiments are complete it is impossible to state positively that the E. M. F. sine-curve is the best or the worst form for minimizing the iron core losses of transformers. Up to the present it has certainly not been shown that it is the best. J. A. FLEMING.

London, Eng.

In a letter of Prof. Fessenden in this column last week the saving of the energy through reduced hysteresis in the case of the curve of the London *Electrician*, by a printer's error was made to read 15 per cent., instead of, .15 per cent., as written. At the end of the fifth paragraph instead of the ratio of amplitudes being 1.7 as printed it should read 1:7. In an editorial in the issue dated September 22 it was stated that Prof. Fessenden held the opinion that peaked curves have no advantage over sine curves as regards hysteresis, whereas in the letter there referred to he states the reverse, with the qualification that the advantage was slight and more than counterbalanced by other losses peculiar to the peaked curve.

How to Make a Dynamo Excite Itself.

To the Editor of The Electrical World:

Sir: In reading Mr. Hanchett's article in THE ELECTRICAL WORLD of Sept. 15th an experience of my own was called to mind which may be of interest. I was installing a new 200-volt compound generator, a counterpart of which was in operation driving a traveling crane and 12 arc lamps, four in series. My assistant while working at the switchboard carelessly disconnected one of the rheostat wires of the running machine causing a bad arc, after which it was discovered that the field had lost its magnetism. The brush connections could not be changed as that would have reversed the arc lamp craters, so the magnetism was coaxed back by throwing on one of the motors and applying "a touching" short circuit at the brushes, relying upon the series winding to build up. It required about ten minutes to get the machine back to normal.

McKeesport, Pa. E. G. MILLER.

Cost of Producing Electrical Energy.

To the Editor of The Electrical World:

Sir: Your issue of September 8th contained a leter from Mr. Max Meyer in which he stated that he should have been credited with the information concerning the German central stations mentioned in my paper read before the Northwestern Electrical Association at St. Paul, instead of Mr. J. Laffargue whom I mentioned as the author of it. The figures I gave were taken from the London *Electrical Review* which quotes them from *L'Industrie Electrique* over Mr. Laffargue's signature, stating that it was copied from the *Elektrotechnische Zeitschrift* The editor of the *Review* in a foot-note states that this information was compiled from various sources and corroborated by the managers of some of the central stations. I do not find mention of Mr. Meyer's name anywhere, although I have not seen copies of the other foreign papers. Had I known that he was the author of the figures I certainly would have given him credit for them. B. J. ARNOLD.

Chicago.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Light from Electrical Oscillations.—A paper by Mr. Ebert from the "Wied. Ann," vol. 53, p. 144, on electrical oscillations of long duration, and their action, is abstracted in the "Elek. Zeit.," September 13. To produce light effects by means of electric oscillations or high frequency currents, the primary and secondary circuits must be so proportioned that the duration of an oscillation for both is equal to $T = 2\pi\sqrt{L\,C}$, in which L is the self-inductance and C the capacity of the condenser; these values of T should be the same for both, or else have a simple harmonic relation; air and oil condensers are therefore preferable to those with solid dielectrics; to diminish the damping, the condensers should have as small a capacity as possible, and for a given resistance of the circuit there should be as high a self-induction as possible, although with such high frequencies as ten to the seventh power, the self-induction is somewhat limited in order that the apparent resistance should not become too great; the ohmic resistance is negligible. He constructed an apparatus on the Lecher principle, which was proportioned as mentioned above and which showed itself as being very effective for the generation of light. He describes a lamp consisting of a glass bulb containing paste of a greenish blue luminous paint on a glass tube inserted in the bulb; on the outside of the bulb and symmetrical to the paste of paint, were two rings of tinfoil with contact wires to which the circuit was connected; cathode rays perpendicular to the bulb were produced and were almost invisible, but on the surface of the luminous paint a bright phosphorescent light was produced; the candle-power was estimated as one-fortieth to one-thirtieth of a candle, the consumption of energy being extremely small; he estimates it as about 1,500 to 2,000 times as small as in the amylacetate standard candle lamp; the light is a mixture of greenish blue and yellow, and if the yellow could be obtained by itself the light would be like that from a gas or petroleum lamp. He believes it possible in this way to construct bright lights which consume only some millionths of a watt; these high frequency currents cannot be sent along lines and must therefore be generated in a small apparatus close to the lamp.

Oscillations.—A paper by Mr. Righi on electrical oscillations of small wave length and their reflection from metals, is published in abstract in "L'Eclairage Elec.," September 15 (vol. 1, No. 1).

Reflection and Resonance from Hertzian Oscillations.—A paper by Mr. Zehnder from the "Wied. Ann.," vol. 49, p. 724 (July, 1893), is abstracted in "L'Eclairage Elec.," September 15 (vol. 1, No. 1).

Propagation of Electric and Magnetic Perturbations.—A mathematical article by Mr. Blondin is begun in "L'Eclairage Elec.," September 15 (vol. 1, No. 1); he proposes to give a resume and the present state of the subject.

Measurements with Electrical Radiation.—A paper by Mr. Zehnder from the "Wied. Ann.," vol. 53, p. 152, is abstracted briefly in the "Elek. Zeit.," September 13; he speaks of the production of an electric spectrum in which a series of different wave length are produced.

Action of Alternating Currents on Dielectrics.—Mr. Addenbrooke in the Lond. "Elec. Rev.," September 14, discusses Professor S. P. Thompson's recent statement that alternating currents have less action on dielectrics than continuous currents have for equivalent mean pressures. He states that as far as he is aware there is no experimental evidence at present to show that the influence of equivalent alternating currents on dielectrics is greater than continuous, or that they have any greater penetrative power as long as the current is nearly a sine curve, and that there are in fact several directly negative facts to such assertions which were pointed out by him several years ago. The sparking distance is greater for a continuous current than for an alternating; he shows that a dielectric will not take its full strain until after a considerable time, measured by several minutes, and that for an alternating current of say, 100 periods, the maximum period only lasts a portion of the phase, the period of voltage above the mean not lasting more than one-six hundredth of a second. He believes that there is no evidence that an alternating current disintegrates the material, although it seems not altogether impossible. He thinks that the sparking in the electrostatic voltmeter at 20,000 volts was probably due to a resonance effect. A badly constructed alternator may give an extraordinarily high maximum for a short portion of its period, in which case it is quite possible that the effect on dielectrics will be more deleterious than with a continuous current.

Movement of Dielectric Bodies in Electrostatic Fields.—The paper of Messrs. Graetz & Fromm from the "Wied. Ann.," vol. 53, p. 85, is abstracted in the "Elek. Zeit.," September 13; a French translation is published in "L'Eclairage Elec.," September 15. They show that contrary to theory a dielectric body will take up a definite direction parallel to the direction of the lines of force in an electrostatic field; an instrument based on this principle was tested and it was found that not only can voltages from 4,700 to 15,300 be measured with ease, but also those of alternating currents of 60 volts; they found that the torque is proportional to the square of the difference of potential. They conclude that contrary to theory it must now be accepted that dielectrics consist of conducting particles surrounded by a non-conducting material, and that they have mutual action on each other.

Magnetic Dielectric.—The Lond. "Elec. Rev.," September 14, recommends a paper by Mr. Birkeland in the "Comptes Rendus," vol. 118, p. 1320, describing experiments which seem to promise that more extensive researches would result in more important discoveries.

Rise of Current in Inductive Circuits.—The Lond. "Elec.," September 14, contains an interesting article by Mr. Russell, in which he discusses, by means of diagrams and very simple mathematical deductions, some theorems connected with the rise of current in an inductive circuit and in branch circuits; he discusses the currents in two mutually inductive circuits, first when one is insulated and short-circuited, and then when both are connected in parallel, giving the current curves in each case. He shows, for instance, that on closing a main circuit which branches off in various inductive paths, there may be produced a reversal of current in some of the branch circuits, and on breaking the main circuit there may be a reversal of current in other of the branch circuits; he considers only the case of two circuits, and states that the facts are very well illustrated by connecting the two coils of an ordinary transformer in parallel and then sending a direct current through them; a galvanometer in series with the high tension circuit first showed a momentary deflection in one direction and then a steady deflection in the other, showing a reversed current in that circuit. He states that it is very easy to devise some very interesting lecture room experiments, showing how, by increasing the resistance of one branch, the reversal of the current can be made to vanish in that branch and take place in the other.

Coefficient of Self-Induction.—The paper by Mr. Guye, mentioned in the Digest, September 15, is contained somewhat more fully in "L'Eclairage Elec.," September 15 (vol. 1, No. 1). The same issue contains another paper by that author on the coefficient of self-induction of N parallel and equi-distant wires of which the sections lie around the circumference of a circle.

Resistance of Solutions Under Pressure.—The Lond. "Elec.," September 14, abstracts briefly from the "Wiener Berichte" for May, results of the researches of Mr. Piesch to determine the effect of pressure on the electrical resistance of solutions; the resistance and polarization were determined simultaneously and pressures up to 600 atmospheres were used; the results were as follows: A change of pressure produced a change of resistance, which decreased in all cases with an increase in the pressure; as the pressure increased the decreases of resistance were less; polarization also showed a change of value with higher pressure, but it is small; an increase of polarization with the pressure was in general observed.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Weston Standard Cadmium Cell.—The "Elek. Zeit.," September 13, contains a long and very interesting article by Drs. Yeager and Wachsmuth, being a contribution from the Imperial Technical Institute of Germany. It gives the results in considerable detail of a very complete series of tests made with this cell in order to compare its properties with those of the Clark cell. The article is well worth the attention of those interested in standard cells, as the tests are probably the most thorough and complete that have yet been made and published. The Weston cell is similar to the Clark, only that in place of the zinc amalgam and zinc sulphate the corresponding cadium compounds are used A description of the cell and the way in which it is made is given. From researches to determine the temperature coefficient they find the following formula for values between 0° and 26°:

$$E_t = E_o - 1.25 \times 10^{-5}\, t - 0.065 \times 10^{-5}\, t^2$$

The formula for the Clark cell for 10° to 30° is:

$$E_t = E_{15} - 116 \times 10^{-5}\,(t - 15) - 1 \times 10^{-5}\,(t - 15)^2$$

They find that the difference between the observed and the calculated values are only very slight, being at most 0.00003 volts; a great advantage lies in the fact that they do not change in the slightest degree after repeated heating and cooling; a comparison with the temperature co-

efficient of the Clark cell, given in a table, shows that at 20° C the Weston cell changes only one twenty-third as much as the Clark; in practice, therefore, the temperature coefficient of that cell need not be considered at all; even in precise measurements only an approximate measurement of the temperature is necessary, and the use of petroleum baths and thermostats is therefore unnecessary. The ingredients, their preparation and impurities, are discussed; it was found that a really saturated solution of cadium sulphate can be obtained only after the salt has been left in the water for some time. Regarding the constancy they found that during the four months covering the period of the test the cells were constant to within one-hundred thousandth part of a volt; but they have a great advantage over the Clark cell in that newly made cells have the same E. M. F. as those which are several months old, while Clark cells arrive at their final value only after several weeks. To test their capability of being transported, two cells were sent by mail from Berlin to Frankfort and back, packed so that at least one of the two was always upside down; subsequent tests showed that the cells did not change during this transportation; an approximate determination of the E. M. F. gave 1.025 legal volts. Their conclusions are that the Weston and Clark cells are equally constant and can be equally well reproduced, but the Weston has the following advantages: its E. M. F. arrives at its definite value immediately after it is set up; the E. M. F. follows changes of temperature very rapidly; the temperature coefficient is so small that the use of petroleum baths and thermostats are unnecessary and an approximate determination of the temperature is sufficient; special care need to be taken only in the preparation of the cadium sulphate in which absolute neutrality and complete saturation are necessary.

(In connection with the above the following information, received by the compiler from Mr. Weston, will be of interest. He states that by observing proper precautions in selecting the materials, and in the putting together of the cells, the greatest difference between any cells should not exceed one in one hundred thousand. Furthermore, the temperature coefficient will be still less than that given if the cadmium sulphate solution be made of a certain specific gravity at a definite and rather low temperature, and if no crystals of the salt be placed in the cell; he lays particular stress on the latter point.)

Wheatstone Bridge with Condensers.—In a paper by Mr. Price, abstracted in "L'Eclairage Elec." September 15 (vol. 1 No. 1) he discusses a Wheatstone bridge arrangement in which the resistances are replaced by condensers; as adjustable condensers with such wide ranges do not exist the method is not applicable; the two condensers having a definite ratio might be made with three metallic plates the middle one of which is moved closer to one or the other, the ratio of their capacities being then easily determined by measuring the distances. An intermediate method can be used, two condensers being used for two branches, and two resistances for the other two, a battery being used as a source and a galvanometer or electrometer for determining the equality of the potential; according to Mr. Gott, this method is a very practical one for comparing submarine cable with standard condensers.

Electro-dynamic Spring Balance.—An instrument made by Hartmann & Braun is illustrated and described in the "Elek. Zeit.," September 13; it may be used as an electrodynamometer or a wattmeter; the movable coil has a very long pointer attached to it to indicate the zero position and its torque is balanced by a long spring, the tension of which is adjusted by a drum having a pointer with a scale, the reading of which is directly proportional to the electro-dynamic force, the coil being brought to its zero position; it can be used for alternating or direct currents.

Testing Singlephase Motors.—In an article by Mr. Esson in the Lond. "Elec. Rev.," September 14, abstracted below under "Singlephase Motors," he describes the following purely electrical method for testing them. The motor was belt-coupled with a small direct current dynamo, the field of which was separately excited; the power given to the armature of the dynamo to drive the motor unloaded, minus the loss due to the resistance of the dynamo armature was taken as the mechanical power loss in the system, in friction of the journals, hysteresis in direct current armature, etc., and is called F; the alternating current circuit is then closed and the motor drives the dynamo, the electrical power given out by the armature of the dynamo being measured; the watts measured at the terminals of the dynamo plus the resistance loss in the armature plus the amount F mentioned above, is credited as the power given out by the motor; this may differ from the power measured by a Prony brake, but only by a very minute quantity; the power used in the friction of the alternate current motor bearings is here credited as power obtained, while with a Prony brake this would not be the case, but by comparing his tests with some Prony brake tests he finds that they accord so completely that the difference between the two sets is quite negligible; any power absorbed due to the slipping of the belt would be against the motor.

Locating a Fault in a Submarine Cable.—Referring to the article mentioned in the Digest last week, Professor Jamieson in the Lond. "Elec. Rev.," September 14, intimates that the method is not new and that it is described in Munro & Jamieson's pocket book.

Fault Current Elimination.—In the Lond. "Elec. Eng.," September 14, Mr. Norman describes a modification of the loop test which is to be used when there is a variable and alternating fault current, which does not stop at zero long enough to make a test; it appears to consist simply in the insertion of a resistance of one megohm in series with a galvanometer, which together form the second circuit to earth.

Photometry and Pupilometry.—The Lond. "Elec. Rev.," September 14, recommends an article by Mr. Henry in the "Jour. Universel d'Elect.," vol. 52, No. 23, p. 514. Gorham proposes a system of photometry based on the measurement of the pupil to which, however, there are objections as other circumstances act upon the pupil; in the present paper means are reviewed and discussed, whereby these measures shall become absolute. (Another paper, possibly the same one, by the same author was mentioned in the Digest, July 7-28 and August 11).

Resistance Alloys.—"L'Eclairage Elec.," September 15 (vol. 1, No. 1) reprints a portion of a book recently published by Mr. Price; the extract contains a brief discussion of the alloys, German-silver, platinum silver, platinoid and manganin, but appears to contain nothing new.

DYNAMOS AND MOTORS.

Singlephase Motors.—In an article by Mr. Esson on mono-phase motors in the Lond. "Elec. Rev.," September 14, he gives the results of tests made by himself about a year ago, with Brown motors of two, one, and one quarter brake-hp for 100 volts and a frequency of 80. The method used in the tests will be found described above under "Measurements." The results show an efficiency of 70.7 per cent. at 1.5 kilowatts, 72.1 per cent. at 0.8 kilowatts, and 71. 4 per cent. at 245 watts, for the three motors respectively, the powers being those given out by the motor. Each armature is wound with two sets of coils, one of which is used only to start the motor as a two-phase motor, the two currents being thrown out of phase by means of a condenser; after starting, the auxiliary coils are cut out; a loose pulley and "striking gear" are used in starting and are said to involve no difficulty, the manipulation of the switch being quite easy; comparing the trouble of starting with that of small gas engines, the mono-phase motor is much to be preferred; the starting current, however, is very high and the power factor very low; the results of the tests are given in a table for various loads including the current, power factor, etc., at starting. In conclusion it is stated that there is still room for a good deal of improvement in such motors.

Theory of the Induction Motor.—A second article of the series by Mr. Kennedy on the elementary theory, is published in the Lond. 'Elec. Rev.," Septemebr 14. He discusses motors which have two sets of poles and use two currents, one lagging behind the other by a quarter of a period, so that when one is at its maximum strength the other is at its minimum or zero value; he uses as an illustration a copper disk capable of rotating between two sets of field magnets; "the currents set up by the one set of poles are acted upon motively by the other set, because the one set of poles is at a maximum flow when the other set is at zero, and the currents induced by one set are at a maximum at the same instant that the magnetic flow of the other set is at a maximum, and thus the motor starts with considerable torque from a state of rest." If, after the motor is started, one of the two currents is entirely cut off the disk will rotate with as much power as it did with the two currents, that is, it will run at a higher speed when at its maximum torque, which leads to the conclusion that two currents are of no use except in starting.

Coupling Alternators in Parallel.—A translation of the article by Mr. Kapp abstracted in the Digest last week, is published with the diagram in the Lond. "Elec. Rev.," September 14.

Motor Generators.—Two forms as made by Swinburne are illustrated in the Lond. "Elec.," September 14, one for delivering direct and alternating currents, for laboratories, experimental shops, etc., and another for charging accumulators at central stations.

Central Station Dynamo.—A full page working drawing, giving the mechanical dimensions, but no electrical data, (not even the output) is published in the Lond. "Elec. Eng.," September 14.

ARC AND INCANDESCENT LIGHTS.

Cost of Incandescent Lighting.—The Lond. "Elec.," September 14, reprints an article from a forthcoming work by Dr. Fleming. He shows that the price is not the only factor to be considered in the choice of incandescent lamps and that consideration should also be given to the rate at which the candle-power decays as well as to the initial efficiency, and the useful life of the lamp; the latter he defines as that part of the life in which its candle-power is not diminished by more than 30 to 40 per cent. of the original candle-power. He shows that the user should determine the total cost to him during that useful life, and calculates several cases, showing that the cheaper is not necessarily the better. The question whether electric light is cheaper than gas cannot be answered by a simple yes or no; he enumerates a number of factors, among which, besides those usually stated, are that it will depend on the constancy of the voltage, the manner in which the wiring is done, the intelligence shown in the placing of the lamps and the care in keeping the lamps clean. A table is given showing the total cost of power in lamp renewals for 200 hours under various conditions, which is useful in making comparisons. To effect economy, the wiring should be done so that, as far as possible, each lamp should have a separate switch, as distinguished from one switch for a group of lamps. For a large class of private houses the average number of kilowatt-hours used per year by an 8-cp 35-watt lamp does not exceed 12 to 20, the latter being generally an outside limit; in clubs, hotels and restaurants, it may reach 30 to 40 and even more; a 16-cp lamp would take about twice that amount; the average total time during which a lamp burns in a private house in a year he gives as 300 to 600 hours. He defines the load factor of a station as the ratio of the actual amount of energy sold to the

amount, which could be sold if the deamnd were constant and equal to the maximum demand.

Alternating vs. Continuous Arc Lamps.—The two systems are briefly compared in an editorial in the Lond. "Elec. Rev.," September 14, to the disadvantage of the alternating arc; one feature which is very detrimental to the alternating arc lamp business is "the insane practice of using so many different frequencies," thus requiring the lamps to be wound for each particular frequency; it recommends that a frequency of about 60 be universally adopted and be made compulsory, which would benefit both the lamp makers and the users, besides giving a great impetus to the alternating motor business. Where a large number of alternating arc lamps are to be used, it would pay to use a rectifying commutator and run the lamps with a unidirectional current, but this would be too expensive, when only a half dozen lamps are used; it is believed that the electrical supply station of the future will give either alternating or continuous currents, according to the desire of the consumer; "when this electrical millenium arrives we have no hesitation in predicting that the alternating arc light will be crowded out by its rival." It believes that we are face to face with a "long felt want" in shape of a cheap and efficient means of transforming alternating into continuous currents.

Projectors.—"L'Eclairage Elec.," September 15 (vol. 1, No. 1) begins a publication of an article by Messrs. Tchikoleff & Turin, translated from the Russian, on the lighting power of projectors with electric light. The original article is from three to four years old and appears to be in the form of a treatise on the subject. The present portion contains a comparison between the inclined and the horizontalz carbons, giving relative figures and showing that in the latter the sum of the luminous rays is 18.6 per cent. greater than with inclined carbons; the Mangin and the parabolic reflectors are discussed, and among other things, the best size of the parabolic mirrors.

A translation of the article on the illuminating power of projectors, which was abstracted in the Digest, August 4, is given in abstract in the Lond. "Elec.," September 14, including the large table.

Mercury Air-Pump.—A new form described by Mr. Kahlbaum in the "Berichted. Deutschen Chem. Gesell.," vol. 27, p. 1386, is highly recommended in the Lond. "Elec. Rev.," September 14.

TRANSMISSION OF POWER.

Transmission Plant.—A description of the Sigmaringen installation is given in "L'Ind. Elec.," September 10, with the aid of a number of good illustrations; the energy is generated by water-power three miles from the town; continuous currents of 1,100 volts and 61 amperes, with a three-wire system, are converted at the distant end by motor generators into current suitable for lighting.

ELECTRIC RAILWAYS.

Liverpool Railway.—The first part of the discussion of the papers by Messrs. Greathead, Fox and Parker, mentioned in the Digest, September 15, are given in full in the Lond. "Elec.," September 14. The discussion is limited almost entirely to the civil engineering features and comparisons with the American roads, and contains but little technical data of importance. An abstract of the discussion was published in the Digest, March 31, the last part of which it now appears was not quite correct and should read that according to Mr. Greathead the maximum tractive force of the Liverpool Railway was 730 lbs. per ton of motor as a maximum at starting, while on the district railway in London the tractive force of the steam locomotive was only 234 lbs. per ton of locomotive, or less than one-third of the above in starting the train. Sir Douglas Fox gives the total cost per mile of different parts of the plant.

Comparative Efficiencies of Electric and Cable Roads.—In a short article in the Lond. "Elec. Eng.," September 14, Mr. Lea makes some deductions from some recently published data on cable roads, showing that as regards efficiency and economical working there is not much to chose between the two systems, and that the only sensible course to adopt is to confine each system to such places as from their nature are specially adapted to the respective systems. He calculates the percentage of horse-power lost in the cable as compared with the maximum horse-power delivered, and finds that it varies in four cases between about 16 and 31 per cent.; the data for electric roads is not on the same basis and cannot therefore be compared with it directly; he concludes that both systems stand at present very nearly on a level.

Mechanical Traction on Street Railways.—The "Bul. de la Societe des Ingenieurs Civils," for July, contains a very long paper, amounting to a treatise on the subject, by Mr. de Marchena, in which he discusses mechanical traction in general as distinguished from horse traction, gives a general classification, and discusses each system in detail, stating in each case the costs and other data; several of the systems are electrical. An abstract of the article is begun in the Lond. "Elec. Eng.," September 14.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Statistics for Switzerland.—The "Elek. Zeit.," September 13, reprints from a Swiss paper some interesting statistics for the year 1893. Tables are given showing the number of installations used for lighting in each of a number of different industries. Particular attention is called to the co-operative companies, which are meeting with favor and in which the stock is held by the users, and it is thought that this will be the principal form of company in the future in Switzerland. Among the new installations for 1893 there are 40, equivalent to 37 per cent. of the total, in which accumulators are used, a percentage which is exceptionally high and shows the great advantage of accumulators, as also the fact that they have now arrived at sufficient perfection to warrant their use. The total number of lighting installations at the end of the year was 677, an increase of about 21 per cent. over the previous year; transmission of power installations numbered 77, an increase of 45 per cent.; electric motor stations (presumably for the distribution of power) numbered 193, an increase of 105 per cent.; accumulator stations numbered 161, an increase of 33 per cent. Among the prime motors over half are hydraulic; good results are being obtained with small petroleum motors and accumulators for isolated plants; in the transmission of power installations, 16 used continuous currents, while 6 used the three-phase current, and one each single and two-phase currents; only two electric railways were constructed during that year; of the 99 motors installed in that year, 31 were for continuous, 23 for single-phase, 4 for two-phase, and 41 for three-phase currents. The highest continuous currents voltage used is 7,000, and the highest alternating current 3,300. Among the large machines was a 100-hp three-phase generator, the speed of which was only 32 revolutions per minute. Besides the totals above given there are installed 1,407 dynamos and motors, having a total capacity of 28,831 kilowatts; there are 145,949 incandescent lamps and 2,126 arc lamps installed.

Uniform Frequency.—The Lond. "Elec. Rev.," September 14, recommends that a frequency of 60 be adopted universally and be made compulsory; on public supplies it should never exceed 65 nor be less than 50; it is claimed that this would benefit both the arc lamp makers and users, besides giving a great impetus to the alternating current motor business.

Electricity in Mining.—The Lond. "Elec," September 14, states that a new colliery, which is being opened near Eckington, is to be worked entirely by electricity.

Combined Plant for Drainage and Lighting.—A report of such a plant for the town of Monmouth is published in the Lond. "Elec. Rev.," September 14.

Governing of Steam Engines.—The Lond. "Elec.," September 14, publishes an article by Mr. Addenbrooke on the governing of steam engines, particularly when coupled with dynamos.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Minimum Current Audible in the Telephone.—A British Association paper by Lord Rayleigh, is published in full in the Lond. "Elec. Rev." September 14. He quotes the results of a number of observers, and as it is difficult to reconcile them with each other, he made a series of fresh observations, with instruments of the Bell type; the tests are described in detail, and the results given in tables for notes of different pitches; they are in general about as follows: the current in amperes is equal to ten to the minus eighth-power multiplied with figures varying from a minimum of 4.4 for a pitch of 640 to 49 for 307, and 2,800 for 128; the figures increase again for pitches higher than 640, showing a period of maximum sensitiveness in this region.

Quantitative Theory of the Telephone.— A British Association paper by Lord Rayleigh on an attempt at such a theory is reprinted in full in the Lond. "Elec. Rev.," September 14.

Researches with Telephone Induction Coils.—The "Elek. Zeit.," September 13, contains an article by Mr. Christiania, discussing the subject of induction coils and describing experiments to study the actions of the induction coils and to find the best conditions for the best effect. He shows that they act not only electro-magnetically, but at the same time as a condenser. His conclusions are that for telephone stations, an induction coil, in which the two coils are wound over each other, is undoubtedly preferable to one wound with a bifilar winding.

Long Distance Telephony.—It was recently announced that a line from London to Berlin was under consideration, but it appears from the "Elek. Zeit.," September 13, that this is a mistake, and that the line is not under serious consideration.

ELECTRO-CHEMISTRY.

An Improved Primary Battery.—The Lond. "Elec. Rev.," September 14, mentions briefly that it had occasion to see the electric launch "Velvoca," in which the cells weighed 30 lbs. each, 48 of which propelled the launch at five miles for ten hours, carrying twelve persons comfortably, a performance which it believes exceedingly good; the expense per horsepower is apparently great, but when everything is considered, this may not prove to be an important matter; a full description is promised; the battery is an improved Smeed type, in which the hydrogen is thrown off by fine filaments of carbon; the inventor believes that a low electromotive force, coupled with constancy and extreme simplicity is preferable; the battery consists of carbon and zinc in dilute sulphuric acid, and gives only half a volt per cell, but is remarkably constant. Some further data is published in the Lond. "Elec.," but as a full description is promised in the other journal, the details will not be abstracted here until next week.

Electrochemical Economy.—An editorial in the Lond. "Elec. Rev.," September 14, calls attention to the present use of water-power in the manufacture of certain chemicals by electric processes; about 600,000 kilograms out of 1½ to 2 million kilograms of chlorate of potash,

quired annually, are made at Vallorbes in France by an electric process by means of a 2,000-hp water-power, and a much larger installation exists in Sweden (see Digest of last week).

A Cheap Insoluble Anode.—Mr. Fitzgerald, in the Lond. "Elec. Rev.," September 14, again calls attention to the fact that lithanode (a conductive peroxide of lead) can be used as an anode in the electrolysis of earthy and alkaline chlorides; he claims that it is cheap, and that his statement that it is absolutely inattackable by electrolytic chlorine and oxygen has never been denied; he also suggests that it might be used as a diaphragm in commercial electrolysis, as it is attacked neither by chlorine nor by caustic alkali.

Electrolytic Production of Nickel and Cobalt.—A new process of Mr. Hoepfner for obtaining these metals in their purest state is briefly mentioned in the Lond. "Elec Rev.," September 14.

Electricity Direct from Coal.—The Lond. "Elec. Rev.," September 14, abstracts Dr. Ostwald's recent paper (see Digest, July 21, under Electro-Chemistry.)

MISCELLANEOUS.

Physiological Effect of Magnetism.—In discussing a recent statement by Dr. Luyes on a magnetized head cap, which is evidently absurd, Dr. Hedley, in a communication to the Lond. "Elec. Rev.," September 14, gives a brief summary of experiments, showing that science knows nothing of the action of magnets on the human body, except the apparent absence of action; if such magnets are used in medicine, and have any effect at all, their action must be purely physical, and that, therefore, a wooden magnet might do as well.

Trolley Balloon.—"L'Eclairage Elec.," September 15 (vol. 1, No. 1), states that the proposed trolley balloon (see Digest, January 27, May 26 and September 8) at the Antwerp Exhibition, has turned out to be a complete failure; some of the data is given. (Why three-phase currents requiring a triple trolley and three trolley wires, was to be used, is not stated.) The cause of failure is not given, but it is stated that the tension on the cable was very great.

Movable Shears.—A powerful shears for cutting bars of metal, driven by an electric motor, and secured on a track on rails, taking its power from a trolley wire, is illustrated in "L'Ind. Elec.," September 10; it is used in a wire factory, and it has been found that there is a considerable saving in time gained by bringing the shears to the work, instead of bringing the work to the shears.

Electrical Steering Compass.—A well illustrated description taken from "La Nature," of the instrument described in the Digest, June 2, is published in the Lond. "Elec. Rev.," Sept. 7.

Balloon Struck by Lightning.—The Lond. "Elec. Rev.," and "Elec.," Sept. 7, record a recent case in which a captive balloon was struck by lightning in a storm, setting it on fire and seriously injuring the men who were about to lower it.

Exposition at Lyons.—"L'Eclairage Elec.," September 15 (vol. 1, No. 1), gives the first part of a description of the distributing stations at this exhibition.

Educational.—The City and Guilds' examination questions on electricity are published in the Lond. "Elec. Eng.," September 14. The same issue contains a lecture at this Institute on the principles of electric circuits, in which hydraulic analogies are given.

Biographical. A biographical notice of the late Professor Von Helmholtz is published in the Lond. "Elec. Rev.," September 14; the Lond. "Elec.," contains an editorial on Helmholtz; a biographical sketch from the London "Times" is reprinted in the Lond. "Elec. Eng."

"L'Eclairage Electrique."—A new French journal, with this title, has just been started, the first number bearing the date September 15, 1894. A circular states that it is intended to fill the place left vacant by "La Lumiere Electrique," which is no longer published, and it will have articles from the same contributors and collaborators. In all but its external appearance it is quite similar to "La Lumiere Electrique," except that it is published in less elaborate style and contains much fewer illustrations. The director is Dr. P. H. Ledeboer, and the subscription price for the United States is 60 francs (about $12). It is published at No. 24 Rue Chauchat, in Paris.

A New Electric Street Railway Journal.

We have received the prospectus of a new weekly trade journal, to be called "The Trolley," which, we learn, is to be "devoted to the interests of the trolley systems of the United States, South America, Europe, Australia, etc." The journal will be published by the Shakespeare Press, Westfield, Union county, New Jersey.

The Electric Canal-Tugboat.

BY F. M. F. CAZIN

Since Archimedes determined the effect of the immersion of a solid in a liquid medium 2,180 years have passed. But it is a very few years only since the effect of the movement of the immersed solid within the medium has found a precise valuation, and many a learned engineer even at this date is unaware of a natural law existing by which this valuation is determined.

The law is expressed as follows:

A solid, when moving in a medium, causes a quantity of the medium to move in a direction inverse to the movement of the solid; and this quantity of the medium inversely moved is as the product of the volume displaced by the first immersion or submersion of the solid by the distance of travel, divided by the length of the solid, such length being measured in the direction of relative motion. And the distance, for which this stated quantity of the medium is inversely moved, is as the said length of the solid. And aside of the quantity of the medium so permanently and inversely moved by the movement of the immersed solid another quantity of the medium is temporarily moved out of its previous position, when the moving solid has a non-uniform transverse section, which other quanity of medium returns, when the solid has passed by, into the same position previously occupied, therefore absorbing no power and offering no resistance. And the quantity of medium only temporarily moved is as the product of the length of travel by the difference between the transverse major section of the solid and the transverse average section of the moving solid. And the transverse average or uniform section of the solid is as the immersed or submerged volume divided by its length, such length being for all cases of relative motion measured in the direction of such relative motion.

From this law, which for the sake of shortness and complimentary to its discoverer is now called "the Cazin displacement law," there has been drawn, amongst many others, the following conclusion:

The power required for producing motion of a ship at a velocity v is as

$$y \times \frac{1}{75} \times \frac{B}{d} \times v \times \frac{v^2}{2g} \text{ metric horse power*}$$

And this power must be directly applied to the moving of the quantity of water per second from bow to stern.

To effect this in the most direct manner, the propeller screw or screws may be located inside of a longitudinal tube open at both ends to the water, that produces buoyancy, such tube leading in a straight line from bow to stern. The most objectionable part of the present construction —the cumbersome and unreliable propeller-shaft may thus be avoided, the motive power being transmitted to the screw at its circumferential line by a geared ring. (Compare the Journal of the Franklin Institute for May, 1893.)

The method of ship propelling thus indicated is herewith illustrated in its application on an electric canal power boat.

It is not the intention here to enter on any discussion as to preferable form of screw or of its necessary dimensions and number of revolutions required for producing a stated power, viz.: for removing a stated quantity of water from bow to stern; but the intention is to describe an arrangement, which closely adapts istelf to the requirements of the case in view of its real nature.

The essential conditions for the construction of a practical electric power-boat for canal traffic, this is for economical and effective towing, therefore, are as follows:

1. That its propelling power be adequate to move in inverse direction to its own travel the quantity of water expressed by $\frac{B}{d} \times v$ metrical tons per second, the value of $\frac{B}{d}$ relating to the entire string of boats to be moved in one close train.

2. That the inversely running current of water produced by the power applied is not diverted from its direct inverse course, that is, not diagonally diverted, but moves from bow to stern of the entire train of boats in as straight a line as practicable.

1. Under the newly discovered natural law hereabove quoted the ultimate and direct requirement of power for not only moving the power-boat but in addition thereto a number of canal-boats, is so specified, that the quantity of water moved inversely by the machinery measures correctly its propelling power. And with this water flowing through a tube, as in the new power-boat proposed, this quantity of water can be easily measured, or calculated, or the dimensions of tube and screw as well as the latter's number of revolutions determined.

The drawing shows an arrangement where within a longitudinal tube passing from bow to stern of the power-boat, there is inserted an other shorter tube, that contains an archimedean screw. The inner tube has two outer rings, one of which runs in supporting wheels and the other of which rings has aside of running on supporting wheels also gearing, into which other gear-wheels work for conveying motion to the inner tube. These power-conveying wheels run in a recess of the longitudinal and longer tube, their shafts passing through the side-walls of the recess and receiving power from electric motors set up in the power-boat.

The inner tube containing the archimedean screw may also run with its wall in a recess of the longer tube.

The present description being intended only to describe the new ar-

* B signifies the ship's immersed volume or its buoyancy in metric tons.

d signifies the ship's length measured in the direction of her motion and on her water-line.

v signifies the ship's velocity of travel or her speed per second, expressed in meters.

$\frac{v^2}{2g}$ signifies the elevation, to which a weight must be lifted for acquiring in its subsequent fall an ultimate velocity $= v$.

y signifies 1,000, by the use of which co-efficient the value of metric tons for B is mopified into kilogrammes, and in consequence the total value into kilogram-meters, of which 75 make 1 metric horse-power.

g signifies twice the distance, which matter, when free to fall will pass in the direction towards the earth's center within the first second of such free fall. This distance g, being as $g = 9.78009 + 0.05080 \sin^2 \psi$ (ψ = geographical latitude) meters.

rangement in general, no claim is made as to accuracy of dimensions or even of form.

2. "From bow to stern" is the condition, the essential condition relating to the flow of the water, that is inversely propelled by the machinery. For the power-boat itself this condition is fully attended to by the water flowing all through the longitudinal tube, which tube, occuping the meta-centre of the boat, is of necessity open at both ends and its inner space is virtually outside of the boat and does not count in making up the buoyancy f the boat.

Care must therefore be taken, that the water ejected at the stern of the power-boat, shall pursue its course to the end of a string of canal-boats without being diagonally diverted. And this is effected by the parallel-rudders, one on each side of the stern part of the power-boat, that will force the ejected water to closely follow the side-lines of the canal-boats, that are closely following the power-boat. The entire string of boats thereby is made to act, as if it were one long moving boat.

As giving superiority to this arrangement when compared with all other older or possible newer form of power-boat and method of canal towing the following facts are claimed:

(1) Under this system the application of the trolley system to canal boat propulsion is made free of all objections, that might be raised against the introduction of this system either on the part of the owner of the canal or on the part of the owners of canal-boats, as will be shown herebelow.

(2) Under this system the provider of power can give to the boat owner double the present speed for the same price, that the boat owner now pays and yet make himself on the price so paid a very large percentage of profit, this is larger profits, than he could possibly make under any other system.

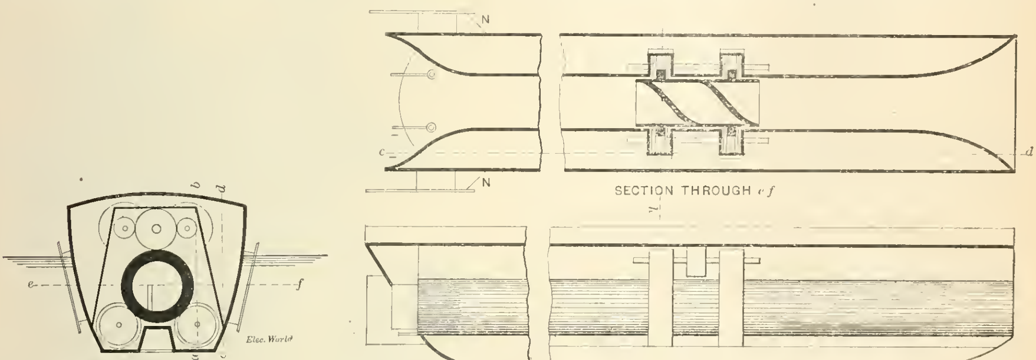
boat under the new system performs many times the work that a steam tug of the same nominal horse-power now performs, even up to 10 to 20 fold of this work as now performed.

And it does so perform a 10 to 20-fold amount of work in the same time, because its construction is adapted closer to the natural conditions of the case and because its method of working is by far more rational than the old method, all of which results in this, that under this new method or system of canal transportation the cost per ton and mile transported at the same speed as against animal traction will be only from one-tenth to one-twentieth of present actual cost and only one-fifth to one-tenth of what the cost would be under the trolley system without the application of the new propeller system and of the making up of close trains made possible under this system, all of which the following calculations will show and prove and all of which practical test will verify.

The two John C. Trautwines in their Civil Engineers' Pocket-Book (Edition 1891, p. 376), when speaking of traction on canals and of the power required for such traction, use yet the following expression: "The whole subject is too intricate to be treated here."

Had the junior author taken cognizance of what in 1886 was published on the subject (See Van Nostrand's Engineering Magazine, Sept., 1886, The Limits of Speed in Ocean-travel) of power required for propelling ships, all intricacy of the subject would under the newly discovered and there published natural law, as it is quoted hereabove, have disappeared.

Present canal-boats on the Erie Canal have a total initial or first displacement (B), when with full load, of 105 metric tons or cubic meters of water, of which 30 tons relate to the boat's dead weight and 75 tons to useful load. Their length on the water-line (d) is 80 ft. or 24.4



SECTION THROUGH ef

SECTION OF HULL THROUGH gh — SECTION THROUGH ab — SECTION THROUGH cd

ELECTRIC CANAL-TUGBOAT.

And the technical causes for these results are as follows:

(a) A propeller arranged as described is more effective than one running at the boat's stern without a circumferential cover, because here is no loss of effect by mere centrifugal action, this is no "slip."

(b) The access of water to the propeller under the new arrangement is a direct and perfect one, being exclusiely in the sole direction, in which it gives propelling effect to the screw, it having been experimentally proven, that a disk in front of any propelling screw destroys its propelling effect entirely.

(c) The water ejected at the stern-end of the power-boat is kept in a true line of flow by the rear-end of the tube widening out, allowing the water to skirt the bow of the next adjoining canal-boat, and is further kept on this line by the parallel rudders set at proper distance by the connecting rods and the hooking rods from the sides of the boat giving direction to the adjoining portion of the canal water, thus forcing the inner current to pursue its course directly towards the stern of the boat-train.

The parallel rudders are set to inclose a wider space than the beam of the following boats and they project beyond the stern of the power boat as far as practicable.

(d) The advancing train under proper execution of the new system displaces at its bow just so much water as must be and is inserted in the space previously occupied at its stern. And no false or diagonal current being produced, there is abolutely no washing of embankments, the only possible wash being below the boat on the line of their travel.

(e) The water ejected between the two inner rudders is instrumental to a quick obedience of the boat to the action of the rudder, the manipulation of the boat being thereby greatly facilitated and a closer range of movement being thereby secured.

It now remains to subject the financial side of the question to a close scrutiny, in order to demonstrate the fact stated under (2) in the preceding statement.

Assuming the cost of the electric power-boat to be not less than the cost of a tugboat with steam boiler and steam engine, and with the cumbersome and costly unreliable propeller-shaft, then the electric power-

metres, and in consequence they have a transverse average section $\frac{B}{d} = \frac{105}{24.4} = 4.303$ square metres, or $= 4,303$ mili square metres.

Two horses do in actual practice tow such a loaded boat for 8 consecutive working hours out of the 24 at a speed of 2 miles an hour, or 3,213.25 metres in 3,600 seconds, or at the rate of 0.8926 metres per second.

This is equivalent to inversely moving $4,303 \times 0.8926 = 3,841$ kilogrammes of water at the speed of 0.8926 metres per second, or from bow to stern. And this work is equivalent to lifting the said quantity of water to an elevation $S = \frac{v^2}{2g} = \frac{0.8926^2}{19.62} = 0.04$ metres.

And to accomplish this a power of propulsion must be applied as follows:

$$P = 1,000 \times \frac{B}{d} \times \frac{v^3}{2} \text{ watts, or}$$

$$P_1 = 1,000 \frac{B}{d} \times \frac{v^3}{2} \text{ kilogrammes-metres, or}$$

$$P_2 = 1,000 \times \frac{B}{d} \times \frac{v^3}{(2g \times 76.04)} \text{ horse-power.}$$

With $B = 105,000$ kilogrammes,

$d = 24.4$ metres,

$\frac{B}{d} = 4,303$ square metres,

$v = 0.8926$ metres,

$v^3 = 0.71113$ metres,

$g = 9.81$ metres, and

we shall find $P = 1,530$ watts,

$P_1 = 156$ kilogram-metres and

$P_2 = 2.183$ horse-power,

Which is in full harmony with the work actually done by life-power, that is by the two horses now used.

But electric canal traction will not probably confine itself to the slow speed of animal traction.

With a traveling speed of 4 miles an hour the 363 miles of the ent re Erie Canal, locks excluded, can be made in traveling day and night, a possibility well secured by the use of electric head-lights, in about 4 days, and including locks, surely in 6 days, or in about half the time it takes with animal power and the incidental loss of time therewith connected.

Paying $3 per horse for 8 hours' real work, the cost to the boat owner per useful load and ton-mile is 75x16 equals 1,200 ton-miles for $60 precisely equals ½ cent per ton-mile.

This is the figure, with which a new venture in providing power for canal traction will have to reckon.

For a speed of 4 miles an hour the above stated figures must be modified as follows:

$$v \text{ becomes } v \times 2 = 1.7852 \text{ metres per second, and}$$

$$v^3 \text{ becomes } v^3 \times 2^3 = 0.71113 \times 8 = 5.689 \text{ metres per second.}$$

And in consequence we find for double speed an eight-fold requirement in power, or

$$P = 12{,}240 \text{ watts, } P_1 = 1{,}248 \text{ kilogram-metres, and}$$
$$P_2 = 17.464 \text{ horse-power.}$$

If electric power derived from a source consisting in the combustion of fuel or in the fall of water would not cost less than animal power, then the motive power at double speed would cost per ton-mile 8x0.5 equals 4 cents, unless the same power would under the new system produce a better effect. By digesting the given figures under the natural law as stated it will be found that with a string of boats closely connected and with the provisions made for keeping the counter-current produced and conditional to the progress of the boats in the proper direction, the number of boats towed by the same power-boat can be multiplied. Getting 8 boats into one train then would leave the cost of propulsion the same, though the speed be doubled. And putting 16 canal-boats behind one power-boat in a close string with all the provisions required in that case to keep the back-current produced by the propeller-screw in the straight direction towards the stern-end of the closely arranged train, the cost of propulsion would be reduced to half, while the speed would be doubled.

It appears, therefore, that aside of the saving produced by substituting the electrical power derived from the fall of water, for animal power, the new system secures with the present or old speed a reduction of cost to only a fraction, say one-eighth or less of the present cost, and with double speed either leaves the cost the same or reduces it, according to whether a train contains 8 canal-boats or more.

At all events there is ample room for allowing to the owner of a boat better conditions either as to speed or as to price of power, or as to both, and for a good margin over cost to the power-producer, aside of the power offered being more reliable and more continuous than animal power, and in consequence more attractive for traffic in heavy goods in general. In this may be found a confirmation of the following statement made by the author of this paper in December, 1891, when the application of electric propulsion to canal traffic as yet was not receiving any attention:

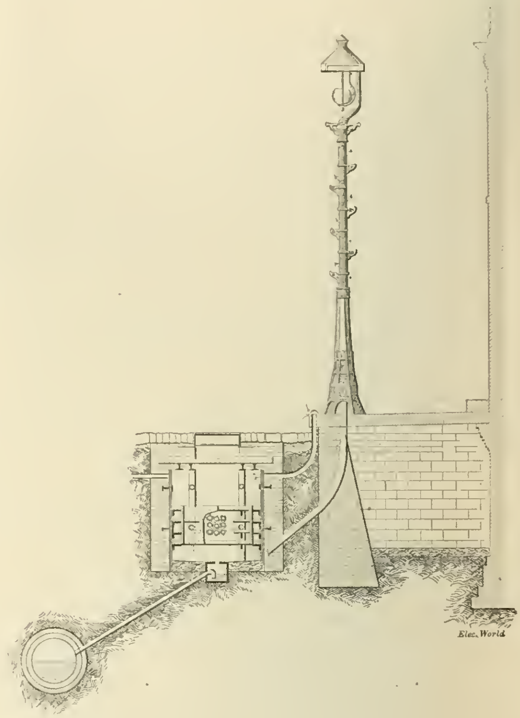
"Were canal transportation made as continuously reliable as railroad transportation has practically become, both for quantity transported and for speed of delivery, it would constitute a more formidable competitor to railroad transportation than it actually is at this date, on account of higher economy in water as against rail-transportation. With a public canal system extensively developed, and a general motive power supplied for progress that will not destroy the canals themselves, and that will never fail but be ready at any time, the intercommunication of the people at large may once again be emancipated from the dominant power now exercised on its political and economical fate by the oligarchy that has arisen, from practical alienation from the people at large of its means of inter-communication for the benefit of a privileged class of financiers.

And this much needed, unfailing, lasting and omnipresent power on the canals of the country can be made available by naught but by electric transmission of power, from where it is obtainable at lowest rate of cost under some such system as the trolley, applied to all vessels navigating the public canals."

In so far as the American system of government does not admit of operating the means of transportation by such government itself, except by contract at large and for mail service, it is of necessity that private enterprise must be relied upon for the realization of this progressive step in national economy.

Underground Wires in Chicago.

The grades of the streets in the central part of Chicago have been raised from 5 to 15 feet. Strong area walls were built on both sides of the street, about 16 feet from the building lines, and the centre of the street filled, leaving a natural basement or cellar between the area walls and building walls. The City Street Department controls the street from building line to building line, and consequently the city has control of this natural basement under the sidewalk, and can use it for its own wires and cables, or give permission to other electric corporations (through the City Council) to do the same. Such permission has been given to several corporations, notably the Chicago Telephone Company, and the Chicago Sectional Electric Underground Company. The city fire alarm and electric light wires and cables where placed under the sidewalk are enclosed in steel pipes, generally 2 inches in diameter. Where they "tap out" to fire or police alarm boxes or electric lamps, a break is left in the pipes, which, after the wires are in position, is closed with a split cast iron tee, so that the wires and cables are enclosed in



UNDERGROUND CONNECTION TO ARC LAMP POST.

iron or steel throughout, thoroughly protecting them from mechanical injury.

The Chicago Telephone Company and the electric light companies renting duct space from the Sectional Underground Company, use this sidewalk space for distribution, the conductors entering it from manholes at street intersections and passing along the area wall in lead covered cables, in some cases protected with iron pipes, or in wooden boxes fastened to the wall, and often with no mechanical protection outside of the lead. The accompanying cut, showing an electric lamp post and pipe entering it from a manhole, will give an idea of the general appearance of the area under the sidewalk. The pipe entering the lamp-post is used as a tube, wherein the wires can be placed and protected, and when perforated above the cast-iron base, it acts as a ventilation for the manhole.

A Novel Application of Accumulators for Traction Purposes.

There is a double-track section of about a half mile of the Chicago North Side Passenger Railroad Company in the heart of the city over which the company finds it necessary to run its cars, but on which it cannot get trolley privileges. For this purpose the Electric Storage Battery Company, Philadelphia, Pa., will furnish the road with trucks, each carrying 240 battery cells of the "chloride" type, but nothing else except a motor-man and a small motor sufficient to run the truck for switching purposes, but not sufficient to run a car.

When a car arrives at the end of the trolley-wire a truck will run in behind it, couple on to it, and connect its battery with the motor on the car, and the motorman on the car will operate it the same as though he had the trolley, the voltage of the current being the same. When the car reaches the end of this section of the line the truck will be uncoupled, mechanically and electrically, switched around by its own motor and connected to another car going back to the other end.

It is expected that on this part of the line there will be 25 cars in use in the busiest part of the day, and the battery company is to furnish 40 trucks equipped with batteries, which will be charged in place on the trucks, the number relieved from duty in the slack times, with the reserve of 15, being estimated as sufficient to allow this to be done.

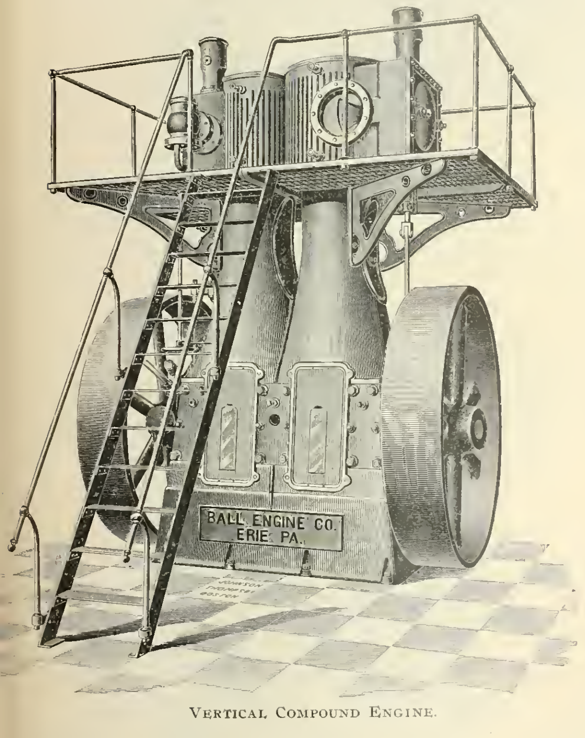
A New Vertical Engine.

In the design of this engine, the makers, the Ball Engine Co., Erie, Pa., have aimed to produce a machine whose structure would be of such a form that the main pieces should be absolutely rigid and indestructible and allow of easy access for adjustment or removal of any part that is subject to wear, and while covering those points to produce an engine whose steam distribution is symmetrical on both sides of all the pistons, whether one, two, three, or four are used; in other words, an independent valve motion for each and every cylinder employed, and each of these being a perfect engine in itself.

By reference to the cut the symmetrical form of the upright housings will be noted, which are made to constitute one double housing by having one side of each planed and bolted together in the centre of the middle shaft bearing. This substantiality is still further increased by the operation of planing the bottom of both housings to one continuous flat surface to meet the planed surface of the top of the single base plate to which the bottoms of the housings are substantially bolted.

The introduction of the shaft into this engine is accomplished by arranging the shaft boxes in a large jaw cutting into one side of the housing deep enough to bring the centre of the shaft in a plane with the centre of the housing, finish spots being provided to meet correspondingly finished surfaces upon the cast iron boxes.

These boxes consist of one lower, two quarter, and one top box for each journal, and these are provided with removable babbitt metal shells upon which the journals bear. These shaft box jaws are in turn closed by the use of heavy struts or plates having on their inner faces a V-shaped tongue on each end, which fits into a corresponding groove



VERTICAL COMPOUND ENGINE.

planed on each side of the jaw. These struts are fitted so that when bolted in solidly by the four bolts in each, the jaw is closed and completes the symmetrical strength at the four corners of each housing. Each strut is fitted so that there can be neither contraction nor extension of the outer end of the jaw.

Each housing is also pierced by a large rectangular opening on each side (shown covered by a door bolted on) as wide as the space between the inner edges of the struts, and extending both high and low enough to allow the cranks with their counter-balancing discs to pass. Hence, with shaft, boxes, and struts in place, to close up the engine it is only necessary to put up and secure large doors, which in turn are provided with a small shutter plate covering an opening large enough for the insertion of one's hand to feel the connecting rod strap when the engine is in motion and to admit the necessary wrenches to key up the crank boxes when so desired. The adjustment of the journal boxes is accomplished by turning the three set screws shown in each strut, the two in the centre reaching the quarter boxes while the third one above operates either in or out a wedge which fills between the upper side of the jaw in housing and the top box. This gives independent adjustment for three parts of each box while the lower box is perfectly free to move at right angles to the axis of shaft, thereby giving for all positions of adjustment of the quarter boxes a full bearing for the shaft.

Above the openings for the shaft the housing becomes a round taper column, having on two sides of its inner surface crosshead guide surfaces which are cast in place and bored out co-incident with the boring and facing of the upper end for the reception of the cylinders and the lower end for a seat upon the base. The other two sides of each housing are pierced by elliptical openings, affording easy access to the crosshead and upper end of connecting rod.

This form of housing makes a structure that is strong, convenient of access when desired, clean as to any dirt leaving the engine, and entirely closed as to any dirt from the outside entering the engine, along with a natural ventilation past the shaft boxes up the column and out of the elliptical openings therein.

The shaft is of one piece of forged steel from end to end, the crank pins being 180 degrees apart and cut out of the solid down to their round diameter, and, as are the journals, ground to a perfectly round smooth running surface. The pins are provided with centrifugal oiling holes in addition to the regular supply through the usual tube reaching from the upper to the lower end of connecting rod.

Covering each pair of crank bells is a pair of discs carrying a sufficient amount of counter-weight to give a perfect running balance to the cranks and the reciprocating parts, so that there is practically no vibration to be communicated to the housings, and hence to the upper works of the engine.

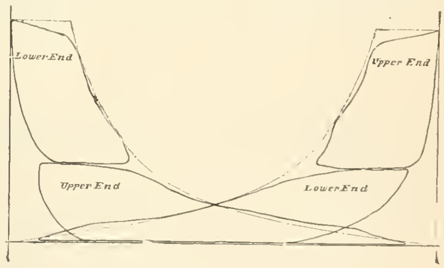
The connecting rods are of forged steel, the upper end being solid and cut out for the reception of the brass crosshead box and the removable crosshead pin—the latter being very carefully tapered through the crosshead and held in place by a fine threaded nut; the lower end is provided with a strap which, owing to the arrangement of bolts and cross keys, constitutes a solid end rod for the crank as well as the upper end, and both ends are provided with a wedge adjustment that in operation does not alter the length of the rod.

The crossheads are of the double plate pocket type, as used in many makes of Corliss engines, and are provided with taper shoes to compensate for any wear that may occur against the guides, the shoes being of cast iron with the large running surface entirely covered with babbitt metal.

The piston rods are of crucible steel, screwed into the crosshead. The stuffing boxes are adapted for the use of fibrous packing unless otherwise ordered. The pistons are of the double plate type, held up to a solid collar and taper by a well-fitted nut. The piston packing is made up of two self-adjusting parted rings and a broad junk ring for centering and guiding the piston in the cylinder.

The cylinders are made of charcoal iron mixed in such proportion of hard and soft as to produce a very strong, close-grained iron which enables the surfaces to take a mirror polish. They are provided with single valves, each of which is practically one piece so far as the motion and wear are concerned.

The high pressure valve is of the double-faced telescopic relief type, with boiler pressure on the inside and sufficient amount of unbalanced



INDICATOR CARD OF VERTICAL ENGINE.

area being left on the faces that the force of the steam on the inside forces the two faces apart, causing each to rub against the seat with sufficient pressure to keep the surfaces polished and steam tight through the entire life of the engine.

The low pressure valve is of the common letter D type with improved proportions and construction, and is provided with a round relief area upon its back operating against the chest cover, being a large, well-proportioned valve that runs with the greatest ease and yet follows up its wear without attention from the outside. The indicator diagram shown demonstrates that where single valves of proper design are used the steam distribution can be made pratically perfect. The one great governing fact in the use of steam is recognized, namely, that a small leakage will more than destroy the useful effect of very elaborately worked out valves and motions. The makers have, therefore, confined themselves to the work of perfecting and simplifying the simplest and best form of steam valve.

A few facts that were developed in a recent test of this engine are as follows:

The engine is employed in electric railroad driving and is supplied with steam at 125 lbs. gauge pressure and exhausts into a practically

uniform vacuum of 24", and was driving (at the time this test for total variation from standard speed was made) 425 to 435 indicated horse-power To observe the variation a tachometer was attached to the main shaft. When all was in readiness and the full load was on, the switch controlling the whole current leaving the station was opened, thus dropping the entire load instantly, and the engine made a momentary flutter up to 235 revolutions and back again to 233 revolutions. The circuit was kept open while the attendant counted ten and was closed as suddenly as it had previously been opened, when the tachometer showed the engine making the same momentary flutter down to 231 revolutions and back again to 233, taking up instantly a load of about 400 indicated horse-power. This test demonstrated that the governor used was in absolutely isochronous adjustment, that the valves were absolutely steam tight, and that this degree of control over an engine of this magnitude using such a pressure and discharigng into a vacuum. was remarkable.

This engine is guaranteed not to vary in speed from full load to no load, and vice versa, more than one per cent., hence as the test showed but eighty-six one-hundredths of one per cent., it was conceded that the guarantee was fulfilled in very good form.

The governor is made of the best materials, the points of severe contact being provided with hardened pins and renewable soft bushings, thus throwing the wear into those parts that are easily and cheaply replaced. The outward appearance of the engine is neat, symmetrical, and at once demonstrates that in this arrangement has been accomplished a great reduction of floor space required for this amount of power.

A Large Water Power Electric Plant.

The Woonsocket, R. I., Electric Machine and Power Company, has extended its electric plant, thus relieving its former station and concentrating its street railway plant in a location that would require less wire, by purchasing a large water power and installing two pairs of 36-inch cylinder gate Victor turbines, which are operated under 17 feet working head and develop 600 horse-power.

Each pair of these turbines, which were manufactured by the Stillwell-Bierce and Smith-Vaile Company, Dayton, O., is mounted in a separate wrought iron flume, to which the water is conveyed from the forebay outside of the building, by means of two wrought iron feeder pipes, which enter the flume nearly over each turbine. Each feeder pipe is supplied with a head gate, by which the water can be entirely shut out of the flumes in case it is found necessary to enter for examination or repairs. The flumes are also supplied with a cover at each end, which can be removed, leaving an opening large enough to remove any part of the turbine.

Each pair of turbines discharges into one draft tube, and with this arrangement, the two turbines discharging towards each other, no steps are required when both turbines are running, as all the end thrusts are balanced, but as the gates of these turbines are arranged so that one turbine of each pair, or one pair and one turbine of the other pair may be run, steps have been supplied. Each pair of turbines has a governor for regulating the speed. Midway between the two flumes is the main driving pulley which is 11 feet in diameter, with a width of face sufficient for a belt 48 inches wide. The speed of the turbine shaft is 133 revolutions per minute, and a belt speed of 4,595 feet per minute is obtained. The pulley is keyed to a steel shaft 7⅞ inches in diameter, which runs in the latest pattern self-oiling swivel boxes. Connecting each end of the shaft which carries the large driving pulley with the shaft from each pair of turbines, is a Worrell friction clutch coupling, so that the pulley may be driven with either or both pair of turbines.

On the floor above the wheels, running parallel with the front of the building, is a heavy line of 6 inch shafting with a receiving pulley with 51½ inches face and 64 inches in diameter connected with the wheel shaft by a three-ply belt 50 inches in width. To the left of the receiving pulley are three driving pulleys, each 69 inches in diameter, and 15½ inches face, each operated by a Worrell or Laconia friction clutch. These pulleys are for driving the power generators, which are connected by 15-inch three ply-belts, and installed on massive brick and stone foundations to solid ground 10 feet below the water line.

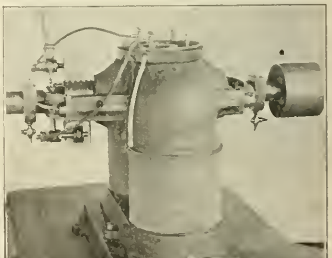
To the right of the receiving pulley is another pulley 69 inches in diameter, with a 15-inch face, operated, as are the others, by a Laconia clutch, which will be used to transmit power to the rooms above as they may be leased for manufacturing purposes.

The three generators placed in this mill will be used in conjunction with another very powerful machine to be located in the old station, to transmit there the water power from this plant when not at all or only partially in use.

Turbines of Woonsocket Plant.

The Roth & Eck Dynamo.

The accompanying cut illustrates a 50-light dynamo manufactured by Roth & Eck, 30 Market street, Chicago. The electrical design and insulation have received much attention. The machines are mechanically and magnetically symmetrical, sparking at the commutator under all changes of lead being thereby obviated. The armature is made up of thin, soft iron discs, separated by thin discs of paper and mounted on a steel shaft. Great care is taken in winding the armatures to secure perfect insulation and mechanical firmness, and they are carefully balanced to avoid jarring when the machine is running. The depth of winding on the armature is small to avoid self-induction in the armature thus preventing sparking. The commutators are made of special hard commutator metal, insulated throughout with mica. The field magnet is large and strong and of the simplest horseshoe type, with cylindrical cores of the softest wrought iron. The wire of the fields is wound on a separate spool; the winding is thus made easily replaceable, and spools can be furnished for any voltage if a change should be desired, which can be made with very little work.



Fifty-Light Dynamo.

New Books.

HOW TO BUILD DYNAMO-ELECTRIC MACHINERY. Embracing Theory, Designing and the Construction of Dynamos and Motors. With Appendices on Field Magnet and Armature Winding, Management of Dynamos and Motors and Useful Tables of Wire Gauges. By Edward Trevert. Lynn: 339 pages, 178 illustrations. Price, $2.50.

This is another of the innumerable works, principally compilations, of that mysterious author, Edward Trevert, who, though the maker of the most extensive list of electrical books ever put forth by one author, is yet, as far as we can learn, utterly unknown to electricians, either in person or by professional reputation. As another singular circumstance, we note that Chapter VIII of this book reprints verbatim and without credit, the contents of a book issued by the same publisher entitled "How to Build a One-Fourth Horse Power Motor or Dynamo," and which has the name, A. E. Watson, on the title page, as author, and that Chapter XIII is similarly a reprint, verbatim also and without credit, of another book by Watson published by the same firm, entitled. "How to Build a 1,000-watt Alternating Current Dynamo or Motor." We find further, that Chapter XI is identical with Watson's book, "How to Build a One-Horse Power Motor or Dynamo," and nowhere do we find any indication that Trevert is not the original author of these three chapters, the use of the personal pronoun, in fact, implying directly the contrary. The latter half of the book consists of descriptions written up to trade cuts, and the greater part of the remaining contents appears to be abstracted from the numerous publications issued under the name of the same author. While the book contains much information that will interest the amateur and assist the beginner, the title is entirely misleading, as in no sense can this fragmentary compilation be considered, as implied, a general work on the theory, design or construction of dynamo-electric machinery.

PRAY'S STEAM TABLES AND ENGINE CONSTANTS. For Facilitating all Calculations upon Indicator Diagrams, or Various Problems Connected with the Operation of the Steam Engine. From reliable data, and with precision. By Thomas Pray, Jr. New York: D. Van Nostrand & Co. 127 pages. Price, $2.00.

The title page states that all of the tables in this work "were computed, not copied" and "compiled from Regnault, Rankine and Dixon, directly, making use of the exact records." There are twelve tables in all, consisting of the usual steam tables, though the arrangement of some of these is different from ordinary practice, with several special ones, as a table of engine constants, one of mean pressure multiples for each .001 of stroke, etc. Those who make lengthy steam calculations will find this book of much service, and it will be found a useful addition to the reference shelves of the engineer's library.

HOW TO BUILD A ONE-FOURTH HORSE POWER MOTOR OR DYNAMO. By A. E. Watson. Lynn: Bubier Publishing Company. 34 pages, 15 illustrations. Price, 50 cents.

HOW TO BUILD A 1,000-WATT ALTERNATING CURRENT DYNAMO OR MOTOR. By A. E. Watson. 28 pages, 15 illustrations. Price 50 cents.

These little books give working drawings for building the machines specified in the tables, accompanied by detailed information in the text. With the information thus furnished the amateur should not find it difficul to construct either of the types.

Electrical Engineering Leaflets by Prof. E. J. Houston, Ph. D., and A. E. Kennelly, F. R. A. S., published weekly by "the Electrical Engineer," New York, are apparently intended to form a course of home study somewhat after the plan of the correspondence schools originated, we believe, by Prof. E. P. Roberts. The leaflets are issued in three grades, elementary, intermediate and advanced, and the two former seem to follow closely the plan of Prof. Houston's recent volumes of Advanced Primers of Electricity, the "syllabus" at the end of each leaflet corresponding to the "primer of primers" at the end of each volume. That the instruction contained in the leaflets is correct, both as to matter and form, the high reputation of the authors gives assurance, and to those who find the reading of the usual text books on electrical subjects too formidable a task, this installment plan of attaining the same object may give the necessary encouragement to become acquainted with electrical principles.

The publisher of "Science" has issued a statement to the effect that after various negotiations with a view to the revival of that valuable journal, the publication of which was stopped on March 23 on account of the difficulty in making collections, a plan of co-operation with the American Association for the Advancement of Science was arranged at its recent meeting, by which the Association grants an annual subsidy to the journal, as do its founders, Prof. A. Graham Bell and the Hon. Gardiner G. Hubbard. To co-operate with the editor and publisher in carrying out the provisions of the agreement, the American Association appointed an Executive Committee, consisting of Prof. W. J. McGee, Chairman, Washington, D. C.; Prof. Franklin W. Hooper, Brooklyn, N. Y.; Prof. R. S. Woodward, New York; and, ex-officio, Dr. Daniel G. Brinton, Philadelphia, President of the Association; and Prof. Frederic W. Putnam, Cambridge, Mass., the Permanent Secretary. Also ten Associate Editors were designated, corresponding to the ten departments of Science recognized in the sections of the Association.

Financial Intelligence.

The Electrical Stock Market.

New York, September 29, 1894.

THE ELECTRICAL STOCK MARKET has been rather active this week, but the bearish sentiment prevailing in Wall street has militated against rising quotations accompanying the increase in activity. Wall street is just now particularly ill-disposed towards the "Industrials," and electrical stocks, coming as they do under this head, suffer the penalty of the unfavorable sentiment current.

GENERAL ELECTRIC has, however, surprised the critics by displaying unusual strength. A flood of gossip in the stock's favor has inundated Wall street. It has been related how efforts during previous weeks to depress the value of the stock have only resulted in the accumulation of an unwieldy short interest, and that any news flattering to the stock must bring about purchases for this account that will lend unusual strength to General Electrics' quotation. This state of affairs has now come to pass, and in consequence General Electric's course has been marked by a strength that rendered it a most conspicuous feature of the entire stock market. If half what is told about the stock is true, then there is ample reason for the good feeling on the stock extant. In the first place the company has now paid off the last dollar of its floating indebtedness, and, after doing so, has still a cash balance of $425,000, besides $125,000 deposited to meet December bonded interest. Indorsements and guarantees now amount to $170,000. Moreover, besides accumulating this cash fund, the General Electric Company has purchased $650,000 of its own 5 per cent. bonds, which are now held in the treasury. These bonds cost, perhaps, $500,000. Add to this the $550,000 cash, and there are quick assets of $1,050,000, with less than $300,000 of interest and endorsements, which latter will soon be paid off. Best of all, it is officially reported that for some time the company's income has exceeded its expenditures to such an extent that it has become a problem how to profitably invest the cash resources. From this statement it may easily be imagined how big a business the company now does. It is now believed that the business of the General Electric Company will put up $15,000,000, this fiscal year, or fully equal to that of last year, whereas some months it was expected that gross business would not be more than 70 per cent. of last year's total. Within the past few weeks, however, business has improved steadily, so that it is now almost double what it was during the panic. Though working to its fullest capacity, the company is pressed with orders, and, as all orders are taken on the new cash basis, people close to the management are looking forward to a very prosperous season. Were it not for the impairment of capital, dividend payments on the preferred stock could be resumed at an early date. Nothing more relative to this matter has, however, developed since what was repeated in these columns last week. Right here it would be well to quote an extract or two from a study of General Electric's situation recently published by the Boston News Bureau. There is a good deal of common sense in the statement that the real strength of General Electric to-day is in the changed basis of the company's operations. It no longer seeks to control by patent monopoly or aggregation of capital, but by the more businesslike plan of manufacturing the largest amount of goods at the minimum of cost. The review has this to say: For some years small concerns have been eating into the manufacturing and supply business of the General Electric by working on special articles. The General Electric has now reached forth to retake the field upon the basis of manufacturing each article at a cost based upon the consumption of the whole country, and the result is seen in the falling of electric supply companies, several of the strongest having gone to the wall very recently. General Electric also has a few large projects on hand where outside sindicates will supply the money and the General Electric Company the apparatus.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101	102⅛
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2⅞	3
General Electric	100	38¼	38½
General Electric pref	—	70	72
Interior Conduit & Ins. Co.	100	35	45
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	34½	35½
* " " pref	50	52	53

BONDS.

*Edison Electric Ill., New York	1,000	107⅝	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	207	208
American District Telegraph	100	41	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	105	110
*Commercial Cables	100	125	145
Erie Telephone	—	51	52
Gold & Stock Telegraph	100	100	105
Mexican Telegraph	100	185	200
New England Telephone		68	69
*Western Union Telegraph		87¾	88
* Ex-div.	100		

AMERICAN BELL TELEPHONE has been the second most active electrical stock, though its operations are confined to the Boston Board. Its stockholders were very much gratified this week by the declaration of an extra dividend of 1½ per cent. out of earnings for the first six months of the year, in addition to the regular quarterly distribution of $3 per share. As the dividend for the corresponding quarter of 1893 was only the regular 3 per cent. without any extras, the improvement in business is clearly evidenced. It is made even more manifest by the publication of the figures of instrument output during the month ending September 20. The gross output was 9,234 telephones, or 5,699 more than in 1893; instruments returned amounted to 6,666, an increase of 305, so that the net output is 2,568, whereas for the same period of 1893, there were 2,826 more telephones returned than put out. The total figures since December 20 last, still show, however, traces of the hard times during the earlier months of the year. Gross output was 62,378, a decrease of 4,784; returned, 53,646, increase $7,937; net output 8,732, decrease, 12,721. These losses will, however, at the present rate of business, be more than made up before December 20 comes around again, so that the year will turn out fully as well if not better than 1893, though that was hardly up to the mark.

WESTINGHOUSE ELECTRIC issues are very quiet. The company has become involved in one or two more lawsuits bearing on infringements by competitors of valuable patents, but this kind of thing has long since failed to arouse any kind of interest in stock market circles. A big business, it is reported, is being done, and many orders will be forced to remain unfilled till the increased capacity of the new Brinton works is given a chance of demonstration.

WESTERN UNION TELEGRAPH stock has not displayed much life of recent days. There continues to be a little investment buying of the stock, but its growing scarcity—in floating quantities—acts as a deterrent on any projected speculative movement in either direction. Quotations are well held.

THE BOSTON ELECTRIC LIGHT COMPANY has declared a quarterly dividend of $2 per share. It is payable to-day.

New Incorporations.

THE PORT HURON & LEXINGTON RAILWAY COMPANY, Port Huron, Mich., has been incorporated to build a street railway.

THE LONDON ELECTRIC COMPANY, London, Ontario, has been incorporated with a capital stock of $250,000. C. B. Hunt is interested.

THE MAYFIELD & STANFORD, JR., UNIVERSITY STREET RAILWAY COMPANY, Mayfield, Cal., capital stock $10,000. J. P. Ponce, B. Mayer, Gordon Wigle and B. L. Ryder are the promoters.

THE NEXOPHONE COMPANY, Chicago, Ill., capital stock $200,000, has been formed to make, sell and lease nexophones and other electrical appliances. F. N. W. Campbell, Freeman Campbell and C. E. Congleton are interested.

THE CITIZENS' ELECTRIC COMPANY, Springfield, Ill., capital stock $60,000, has been formed to produce and supply electricity for light, heat and power, etc. J. McCreery, F. D. Buck, T. H. Coleman, P. N. Harts and E. A. Wilson are interested.

THE NATIONAL TELEPHONE CONSTRUCTION COMPANY, Gainesville, Tex., has been incorporated by J. M. Dubois, Geo. P. Funkhouser, J. M. Lindsey, L. B. Lindsey and C. R. Smith, to build and operate telephone lines. The capital stock is $25,000.

THE CUMBERLAND LIGHT, HEAT AND POWER COMPANY, Mechanicsburg, Pa., capital stock $50,000, has been formed to supply light, heat and power by means of electricity to that town. Geo. W. Cumbler, Fred H. Alleman and J. D. Lander, Steelton, Pa., are interested.

THE ELECTRIC RAILWAY & PARK COMPANY, Clinton, Iowa, capital stock $40,000, has been formed to construct and operate street railways, and to own and operate a pleasure park. A. L. Schuyler, C. Coa, E. C. Walsh, A. L. Stine, M. A. Walsh, J. W. Walsh, all of Clinton, are interested.

THE GARVIN ELECTRICAL MANUFACTURING COMPANY, Portland, Or., capital stock $5,000, has been formed to manufacture, purchase and lease telephones, phonographs and all other classes and kinds of electrical inventions. Wm. H. Garven, Thos. B. Howes and S. I. Barber, Portland, Ore., are the organizers.

THE TEXAS PACIFIC MERCANTILE AND MANUFACTURING COMPANY, Ft. Worth, Texas, capital stock $20,000, has been formed to construct a telegraph and telephone line, etc. R. D. Hunter, H. C. Edrington, H. K. Thurber, S. Mims, W. G. Newhy, Ft. Worth, Tex.; and C. V. Siddell, New York, are the promoters.

THE N. W. TURNER COMPANY, 29 Bromfield street, Boston, Mass., capital stock $10,000, has been formed to purchase and sell electric and gas fixtures, lamp goods and merchandise at wholesale and retail. C. B. Knott, 22 St. Johns street; W. T. Knott, 29 Bromfield street, and Wm. F. Schallenbach, same address, are the incoprorators.

THE CO-OPERATIVE CONSTRUCTION AND SUPPLY COMPANY, Norwalk, O., capital stock $20,000, has been formed to construct, repair, make and sell steam power, electrical current, and electrical and hydraulic engineering works and fittings, etc. D. B. Kuhn, Wm. S. Bayley, Wm. J. Bowen, J. Comesky and M. Muller are interested.

THE AMERICAN ELECTRIC SMELTING COMPANY, Wheeling, W. Va., maximum capital stock $1,000,000, has been incorporated to manufacture aluminum and other metals by electric or other processes for the production of articles of like nature, etc. John A. Campbell, Charles Menkenmeller, Thomas H. B. Haase, Wheeling, are interested.

THE WADSWORTH GENERAL ELECTRIC COMPANY, Wadsworth, Ohio, capital stock $10,000, has been formed to build and operate electric railways, telephone and telegraph lines, to furnish electric power, etc. W. B. Hunsberger, E. Overholt, J. A. Clark, A. M. Back, F. G. McCauley, O. V. Dibble, J. P. Baldwin and J. G. Grisemer are the promoters.

THE ELECTRIC POWER COMPANY, Los Angeles, Cal., capital stock $1,000,000, has been formed to develop, sell and distribute electricity for light, heat and power; to build electric, water and other works, railway lines, etc., and to operate same. E. C. Seymour, P. Kehl, W. E. Van Slyke, San Bernardino; M. L. Graff and H. W. Latham, Los Angeles, Cal.

THE PHILADELPHIA, BALA AND NARBERTH RAILWAY COMPANY, Philadelphia, Pa., capital stock $24,000, has been formed to construct, maintain and operate an electric railway. The promoters are A. L. Fretz, Cynwyd; G. Morris Dorrance, Bristol, and J. L. Stadelman, Bala, Pa.

THE CHILLICOTHE ELECTRIC RAILROAD, LIGHT AND POWER COMPANY, Chillicothe, Ohio, capital stock $100,000, has been formed to build, acqurie and operate electric, horse or other motive power street railroads, and to furnish electric light and power, etc. Joseph P. Myers, John A. Poland, W. A. Story, Richard Enderling and Joseph M. Klingelsmith are the promoters.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, Oct. 1, 1894.

ALLAN R. FOOTE, of Washington, was in the city last week.

H. B. COHO & CO., 203 Broadway, announce the sale of some small Mather generators the past week, one being for export. They feel quite encouraged by the outlook for business.

MR. C. C. CALDWELL is giving successful stereoptican exhibitions at county fairs and elsewhere, one of the principal features of which is a large number of views of electrical applications.

MR. HALL, of the C. & C. Electric Co., 143 Liberty, street, New York, reports business steadily improving to such an extent as to leave no doubt of the revival of business having a substantial nature.

MR. WALTER F. PHELPS, president of the Dayton, Ohio, Fan and Motor Company, is in New York on a vacation trip. Mr. Phelps reports business excellent, and he feels highly encouraged as to the prospects for the future.

MR. BEN NAHM, president of the American Electrical Manufacturing Company, St. Louis, manufacturer of the American incandescent lamp, has established a New York office at 105 Havemeyer building, of which he will take personal charge.

MR. FRANCIS JEHL, an electrical engineer who has been connected with the old Edison Company in Europe for the past fourteen years, arrived on the steamship Paris of the American line Saturday, September 22. He will shortly locate in this city, where he will represent the firm of Hardmuth & Co., the well known graphite pencil and electric light carbon manufacturers of Vienna, Austria.

ELECTRIC CARS TO CARRY MAILS.—Second Assistant Postmaster General Nelson is giving a deal of attention to special mail service in large cities. He has ordered prepared maps of all large cities showing the surface car lines, with a view of having mail cars run over them. He expects to give his attention especially to carrying mail on electric cars which run from centers of cities to the suburbs and to adjoining smaller towns.

R. F. DOWNING & CO., 13 Williams street, New York, have now ready for delivery their new United States Customs Tariff manual. The book contains 532 pages in convenient hand book form. The alphabetical schedules embrace twenty thousand articles of import, designated by their trade names, with proper rates of duty set opposite the paragraphs in the text of the bill, and references to all decisions of the Courts, Appraisers and Treasury up to date. In addition they have included special articles on doubtful points, together with tables for the reduction of foreign currency, rates of storage and labor at this port, customs capacities of liquors, and many other specia1 points. Every line has been carefully revised by the best customs experts. The price of this valuable compilation is $1.00.

THE NORFOLK & WESTERN RAILROAD COMPANY will run a special train to the Convention of the American Street Railway Association, leaving New York, October 15, at 3 p. m. and reach Atlanta at 6 p. m. the next day. A special car will be reserved for gentlemen accompanied by ladies. Among the prominent passengers by this train will be the following: Benj. Norton, president Atlantic Avenue Railroad Company; Jas. H. McGraw, "Street Railway Journal"; E. Peckham, Peckham Motor, Truck and Wheel Company; Henry C. Payne, president American Street Railway Association; P. C. Ackerman, American Electric Company; E. Martin, vice-president Hamilton Street Railway Company; C. O. Baker, Jr., Complete Electric Construction Company; Wm. J. Richardson, secretary American Street Railway Association; E. J. Wessels, Genett Air-Brake Company; Geo. F. Porter, secretary National Electric Light Association; J. B. Griffith, manager Hamilton Street Railway Company; W. J. Clark, General Electric Company; T. E. Crossman, assistant to secretary American Street Railway Association; Wm. W. Cole, superintendent West Side Railroad Company, Elmira, N. Y.; H C. Evans, the Johnson Company; Lewis J. Perine, Jr., president Trenton Passenger Railway; J. H. Woodward, Benedict & Burnham Manufacturing Co.

Canadian Notes.

Ottawa, Sept. 27, 1894.

ROBIN & SADLER, Montreal, have removed to 511 William street, just a few steps around the corner from the old stand, and opposite John McDougall's Caledonia Works.

STRATFORD, ONT.—The City Council has adopted a scheme for acquiring its own electric light plant, and proposes building a fire hall and electric light station combined. The scheme, it is claimed, will effect a saving all round of between $3,000 and $4,000 per annum.

WINNIPEG.—George H. Campbell, of the Winnipeg Electric Railway, will, with other investors, shortly apply to the Department of Agriculture for a patent on a new agricultural machine. It is described as a "combination of ten plows and thresher, the machine going through the fields at the rate of about two acres an hour and threshing at the rate of 1,000 bushels per day.

TORONTO.—Engineer Keating's report on the electric light tenders was considered by the Fire and Light Committee. The report of Mr. Keating states that the lowest tender received for street lighting is that of the Toronto Electric Light Company, it being 20½ cents per night, or $74.82 per light per year. The tender of Bertran & Co. is pronounced the most satisfactory of those received for engine equipment, and includes boilers, feed pumps, condensers, water and steam piping, etc. The total amount of the tender is $78.729. The Brush Electric Company, of Cleveland, O., put in the lowest tender for dynamos, the price being $27.201 for twelve 125 arc light machines. The same company is the lowest on lamps, their bid being $23 each for double carbon arc lights.

OTTAWA, ONT.—The Government Statistician has prepared a statement on the subject of lighting in Canada. The establishments in this group have increased from 108 in 1881 to 225 in 1891. Mr. Johnson's comment on this group is: "In this group considerable changes have taken place during the ten years. Electricity has been given a commanding position, and though gas works have increased from 36 in 1881 to 49 in 1891 and their continued value to the wage-earner is seen in the fact that 1,164 hands were employed in 1891 against 1,062 in 1881, yet against the two employed returned in 1881 as connected with electricity there were 1,190 wage earners in 1891. Electricity as a motive power has been adopted by thirty companies, having 256 miles of railway thus operated. This development has its influence upon other industries, such as street car building, and any industries in connection with iron and steel, etc."

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, England, Sept. 19, 1894.

GAS MOTOR CARS.—In a recent presidential address to the Institution of Mechanical Engineers, Prof. A. B. W. Kennedy excited the ire of electrical engineers up and down the country by his eulogistic references to the gas motor car. Prof. Kennedy was promptly informed by all electric traction men that he had mistaken his vocation, and the many advantages which the electric car has over the gas car were hurled at his head. It must be said that up to the present the gas car has scarcely justified its existence. A car with all the latest improvements has been running for some little time past down at Croydon, and even if we leave out of consideration the liability to explosion and the expense, the smell, heat and the noise should be quite sufficient to make the unsophisticated public prefer the electric car. However, notwithstanding all this, a line which it was generally supposed would be run by electricity, viz., that from Blackpool to St. Anne's and Lytham, it would now appear is to be operated on the Luhrig self-contained gas car principle. The line is some eight miles long, and will derive its income chiefly from holiday traffic. It will be interesting to observe whether the contract cost of running, 4½ per car mile, including gas, drivers' wages and repairs, will be profitable in practice.

ELECTRIC COMMUNICATION WITH ROCK LIGHTHOUSES.—At the conclusion of the inquiry into the recent stranding of the magnificent Cape liner "Dunottar Castle" on the Eddystone rock, the representative of the owners said they courted the inquiry because it seemed to them to attract attention to the absolute necessity for having telegraphic communication between rock lighthouses and the shore. In this case the value of the ship and cargo amounted to over £300,000, and there were 400 souls on board, and the ship was within measurable distance of being totally lost for want of assistance which might readily have been obtained from Plymouth if there had been the means of communication. The court, after giving juddgment, added, with reference to the suggested cable, that it would consider the subject and report thereon.

LOCAL AUTHORITIES AND TELEPHONE POLES.—Local authorities, especially in Scotland, have lately shown a strong disposition to imitate the somewhat arbitrary methods which apparently obtain in the United States in regard to telephone poles and similar public obstructions. Thus the Fife County Road Board has recently addressed a peremptory ultimatum to the National Telephone Company to the effect that it must pay the Board a rent of two shillings per pole per annum, or "lift them."

"L'ECLAIRAGE ELECTRIQUE."—Within a month of the disappearance of the old established French journal, "La Lumiere Electrique," M. Paul Ledeboer has stepped into the gap with a similar publication called "L'Eclairage Electrique."

News of the Week.

TELEGRAPH AND TELEPHONE.

CALVERT, TEX.—Jas. T. Fuller is building several telephone exchanges.

GAINESVLLE, FLA.—The Bell Telephone Company are about to put in a telephone exchange.

VICKSBURG, MISS.—The construction of a telephone line from Vicksburg to Port Gibson is proposed.

RICHMOND, KY.—Chas. S. Powell and others have been granted a franchise to construct a telephone system.

FLORENCE, S. C.—C. L. Goodman and W. B. Willeford, Atlanta, Ga., are arranging to establish a telephone system in Florence.

WACO, TEX.—A company from Chicago, Ill., represented by Chas. R. Pengilly, contemplates the esablishment of a telephone exchange in Waco.

ABBEYVLLE, LA.—D. L. McPherson is organizing a company to establish a telephone exchange, and is in the market for the necessary equipment.

NATCHEZ, MISS.—The Great Southern Telephone Company contemplates constructing a telephone line from Natchez to Vidalia, including a cable in the Mississippi river.

NATCHEZ, MISS.—The Great Southern Telephone & Telegraph Company contemplates constructing a telephone line from Natches to Vidalia, including a sunken cable in the Mississippi.

GREENVILLE, TEXAS.—The Western Telephone Construction Company will establish the proposed telephone exchange in Greenville. J. M. Ragsdale, of Waxachachie is at the head of the enterprise.

BERLIN, WIS.—The Waushara Telephone Company was organized in Berlin, to construct, maintain and operate a telephone line from Berlin to Wautoma and other places. John Moffott, of Poy Sippi, is president.

ELECTRIC LIGHT AND POWER.

PLANO, TEX.—The establishment of an electric light plant is contemplated.

IRVINGTON, N. J.—A new town hall will be erected, to be lighted by electricity.

MARTIN'S FERRY, O.—The proposition to issue $30,000 electric light bonds was carried.

SUDBURY, ONT.—An electric light and water works are to be established in Sudbury, at a cost of $40,000.

GREENVILLE, ALA.—The Greenville Mills and Ice Factory contemplates erecting an electric light plant.

WACO, TEXAS.—The Mayor authorized the Gas Committee and City Engineer to prepare plans for city lighting.

QUINCY, FLA.—The Owl Cigar Company will establish a cigar box factory and put in an electric light plant.

WINNEBAGO CITY, MINN.—The Village Council is investigating the matter of putting in an electric light plant.

BARTOW, FLA.—Steps are being taken to secure the erection of an electric ight plant. The Mayor can be addressed.

BANGOR, ME., is agitating the question of putting in a new electric light station at the water-works, to cost $25 000.

ST. CHARLES, MO.—A movement is on foot for the establishment of a municipal electric light plant in that city.

GREENVILLE, TEX.—Messrs. Moffitt and Goldsby and W. H. Goldsby are reported to be erecting an electric light plant.

NEW BIRMINGHAM, TEX.—Wm. C. Cloyd can give information regarding the construction of an electric light plant for that city.

MOBERLY, MO.—W. F. Elliott can give information concerning the organization of a stock company to erect an electric light plant.

NOKOMIS, ILL.—The city has issued bonds for a water system, and is considering the question of putting in an electric light plant.

WEST CHESTER, PA.—A new electric light plant is needed. Member Heston, of the Borough Council, can probably give information.

MOBERLY, MO.—The organization of a stock company to erect an electri light plant is proposed. W. F. Elliott can give information.

MORGANFIELD, KY., is putting in an electric plant, the power to be furnished by an engine built by the Ball Engine Company, Erie, Pa.

GREENVILLE, ALA.—The Greenville Mills and Ice Facory are in the market for electric light machinery and desire correspondenc regarding the same.

ASHLAND, KY.—A move is reported on foot for the organization of a company to establish an electric light plant. The proposed capital stock is $8,000.

HOPKINSVILLE, KY.—The Hopkinsville Water, Light & Power Company, Hopkinsville, Ky., has submitted a proposition to light that city by electricity.

MT. MORRIS, N. Y.—Mr. Cariton, a mechanical engineer from Buffalo, accompanied Mr. Metzer to prepare plans and specifications for the electric light plant.

CARBONDALE, PA.—A franchise was granted to the Carbondale and Forest City Electric Street Railway. It will build through Gordon avenue and other streets.

LEBANON, N. H.—The Lebanon Electric Light & Power Company is installing a 150-hp cross compound engine, built by the Ball Engine Company, Erie, Pa.

ALEXANDRIA, LA.—The Southern Electrical & Supply Co. of New Orleans, has been awarded a contract for constructing an electric light and water works for that city.

LULING, TEXAS.—The question of lighting the city with electricity is again being agitated. Luling, with her splendid water-power, could operate the plant at a low cost.

COWPENS, S. C.—J. E. Duval, Charlotte, N. C., has been awarded the contract for installing a 250-light electric plant in the mill of the Cowpens Manufacturing Company.

SPRINGFIELD., TENN.—Address J. W. Bell concerning the lighting of that city by electricity.

NORFOLK, VA.—E. J. Acker, of the Acker Consruction Company, has applied for a franchise to furnish gas and electric light and to construct a sewerage system in Brambleton.

TACOMA, WASH.—A. J. Haywood is interested in a project to develop the water power of the Nisqually river by a dam, to operate the city electric light plant. The estimated cost is $75,000.

HAMDEN, N. Y., is talking about electric lights. It has been estimated the cost will be $300 per annum, owing to the free use of water power, which a citizen has consented to donate.

BIG RUN, PA.—The Big Run Manufacturing Company is in the market for a second-hand outfit, complete, with the exception of power, for elecric lights, 100 to 150 lights capacity.

MERIDIAN, MISS.—C. M. Rubush has been awarded the contract by the Meridian Gas Light Company for the erection of its new electric plant to take the place of the one recently burned.

PEORIA, ILL.—The special committee recommended that the County Board appropriate $5,000 for the erection of an electric plant to light the county buildings, and that plans and specifications be prepared.

OSWEGO, N. Y.—Sealed proposals will be received until October 15, for supplying electric lights in the streets and municipal buildings for a term of five years, from February 20, 1895. Address Board of Public Works.

CYNTHIA, KY.—Sealed proposals will be received until October 9 for furnishing not less than 25 arc lights of 1,200 nominal candle-power each, and not less than 40 incandescent lights of 24 cp each. L. S. Williams is city clerk.

OAKLAND, ME.—The Waterman Machine Tool Company is in the market for a new or second hand electric lighting outfit; also 10-hp dynamo, about eight arc and from 25 to 50 incandescent 16-cp lights, wiring, etc., complete.

PELZER, S. C.—The Pelzer Manufacturing Company will build a new cotton mill and is considering the matter of having it operated by electric power, to be generated at a point two miles from the mill site. S. Clark is superintendent.

PORTLAND, ORE.—The plant of the Portland Electric Company, which had just arrived from Lynn, Mass., and was not unloaded, has been burned. The plant occupied the whole train, and the machinery was of the most expensive kind.

SHIPPENSBURG, PA.—The Shippensburg Electric Light, Heat & Power Company has secured a renewal of its contract to light the streets of Shippensburg, Pa., for three years from October 1, 1894, to furnish 19 2,000-cp arc lamps at $70 per lamp per annum, and 11 32-cp incandescent at $18 per lamp per year, dusk to midnight, moonlight schedule.

ROME, N. Y.—Sealed proposals for lighting the streets of Rome with electric lights will be received until 7.30 p. m., October 15. Proposals must be for one, three and six years, for 150 arc lights, more or less, of 2,000-candle power, to be lighted every night from sunset to sunrise. For further particulars address Alderman Charles A. Fowler, chairman of Lamp Committee.

AVON, N. Y.—The Avon Electric Company has organized, with Mr. C. J. Bastendorff and A. E. Young, of Le Roy, N. Y. These gentlemen are building a solid stone fire-proof building for a power house, having received a contract for five years for 25 arc lights to light the village. They have bought a 50-kw Fort Wayne 1,000-light alternator and a 35-light Wood arc machine complete, with double lamps and other equipment. The plant will be in operation by the first of November. O. K. weather-proof line wire and Schieren's perforated belts will be used.

THE ELECTRIC RAILWAY.

ST. AUGUSTINE, FLA.—Bonds to the amount of $150,000 will be issued to build an electric line.

ASHVILLE, N. C.—J. E. Dickerson is in the market for new or second-hand vestibuled closed cars.

LANCASTER, PA.—The Lancaster Construction Company will build the new electric road at New Holland.

FREEPORT, ILL.—The Freeport Electric Railway has purchased a 150-hp engine from the Ball Engine Company, Erie, Pa.

MANITOU, COL.—An electric road will be constructed at a cost of $50,000. It is reported that the road will be in operation April 1.

RALEIGH, N. C.—The Raleigh Street Railway Company is reported to be arranging to put in a system of incandescent lighting.

DELAND, FLA.—It is reported that work is to begin on the proposed electric railroad at an early date. John B. Stetson is interested.

LANCASTER, PA.—New York capitalists are surveying a line from Trenton, N. J., to Lancaster, Pa., for the purpose of building an electric road.

MOUNDSVILLE, W. VA.—Contractors are making estimates for constructing an electric railway. Wareham & Hughes, Beaver Falls, Pa., are interested.

BALTIMORE, MD.—The Baltimore Traction Company is about to put an additional 500-hp engine in the Retreat street power house; also an engine in the St. Charles street power house. Frank Hambleton is chief engineer of the company.

SYRACUSE, N. Y.—The Syracuse Street Railway Company has been granted permission by the State Railway Commission to use electric power on the People's Line.

BENNINGTON, VT.—A movement is on foot to build an electric line. H. S. Bingham, president of the village, was elected chairman, and Harry T. Cushman secretary.

INDIANAPOLIS, IND.—The Indianapolis, Alexandria & Marion Electric Railway is said to be a sure thing and the work of construction will shortly be commenced.

HOUSTON, TEXAS.—The Houston Suburban Railway Company has been granted a franchise to build a road along several city streets. Judge J. G. Tod may be addressed.

RICHMOND, VA.—The City Council will endeavor to have the Richmond Railway & Electric Company use electric motors on its Broad street line. G. E. Fisher is general manager.

DANBURY, CONN.—The Wardwell Bros., of New Haven, Conn., have been awarded the contract for constructing the Danbury and Bethel electric road, to be completed by January 1.

M'KEESPORT, PA.—The Highland and Dravosburg Electric road has leased the McKeesport & Reynoldton road, whose tracks are laid to the Dravosburg bridge over the Monongahela River.

BLOOMFIELD, N. Y.—At the meeting of the Bloomfield Township Committee an ordinance was introduced granting the Suburban Traction Company permission to use electricity in running cars.

DELAVAN, WIS.—Chicago parties have petitioned the City Council for right of way for an electric line from Delavan to the lake. Should the franchise be granted work will commence right away.

CHATTANOOGA, TENN.—The North Chattanooga Electric Railway Company proposes to build an incline road up Walden's Ridge. The promoters of the new line are C. E. James and T. J. Nichol.

PHILADELPHIA, PA.—An ordinance has been passed granting permission to the East Aramingo Passenger Railway Company to lay tracks on Aramingo avenue, erect poles and operate the road with electricity.

QUINCY, MASS.—The Quincy & Boston Street Railway Company has petitioned the council for a location for the extension of its tracks on the northerly side of Willard street. Christopher A. Spear is clerk of Council.

COVINGTON, KY.—The South Covington Cincinnati Street Railway Company, of which J. J. Shipperd is president, will rebuild its line. Electric equipment, poles, rails, etc., for three miles of track will be needed.

COLUMBUS, GA.—The Columbus Railroad Company is contemplating the erection of a power house to operate their lines by electricity.

CANAJOHARIE, N. Y.—It is an assured fact that Canajoharie is to have an electric road, to run to Sharon Springs and to connect with the New York Central & West Shore Railways. The business men will call a meeting and act at once.

WESTERLY, R. I.—It is not at all improbable that before another year there will be an electric road between Westerly and Potter Hill. The officials of the Pawtucket Valley Street Railroad Company are now considering whether the extension is advisable.

NEW ORLEANS, LA.—The New Orleans Street Railway Company has decided to use the trolley system for its lines, and will rebuild them for this purpose. L. T. Petitpain is secretary and H. J. Malochee, engineer. Nineteen miles of track will be laid in all.

CHATTANOOGA, TENN.—It is reported that the North Chattanooga Electric Road is to be extended to the foot of Walden's Ridge, in the suburbs, and an inclined cable road built to the summit of the ridge. T. J. Nichol and C. E. James are said to be interested.

BALTIMORE, MD.—The Baltimore Traction Company will put in an additional 500-horse power engine in its Retreat street electric power-house; also, a similar engine in its South Charles street power-house. Frank Hambleton is chief engineer of the company.

SYRACUSE, N. Y.—Active measores are being taken towards organizing a new electric street railroad company. Those interested are: Frank M. Bonta, Dr. D. H. Murray, Nathan F. Graves, Allan Fobes, Lyman Stevens, Newell F. Loomis, Alfred Wilkinson, Donald Dey and others.

GETTYSBURG, PA.—The electric power-house at Gettysburg, which was destroyed by fire September 11, caused a loss of about $60,000 to Mr. Hotter, the owner, who was preparing to extend his electric road in order to utilize his power and get a better return for his investment. It will be rebuilt at once and on a larger scale.

SALINA, KAS.—L. N. Erb, of Leavensworth, has made a proposition to the citizens of Salina to build an electric street railway five miles in length in this city, for a bonus of $30,000 in real estate and $500 in cash. A mass meeting has been held of the business men and capitalists and the proposition was accepted. Work will be started in thirty days.

OLD FORGE, N. Y.—The Old Forge Railroad Company has been incorporated to construct a street surface railroad two miles in length from the Fulton Chain Station, on the Adirondack and St. Lawrence Railroad, to Old Forge. John F. Luther, Charles N. White and Luella Luther, of Utica, Leander W. Fiske, Morton Henks and Dayton M. Hall, of Boonville, are interested.

WASHINGTON, D. C.—The proposed electric railway between Washington and Baltimore is now reported as fully decided upon. Surveyors have been fixing the final line of the route between Riverdale and Washington, and the entire route has been definitely settled upon. By act of the last Maryland legislature, the charter was extended six months from the first of August last.

CHICAGO, ILL.—The North Chicago Street Railway Company has applied to the Commissioner of Public Works for a permit to build and equip with electricity its lines, with proper side pole construction, on Garfield avenue from Lincoln west to Racine avenue, south on Racine avenue to Center street, and thence east on Lincoln street to Lincoln avenue and Sedgwick street. The work is to commence at once.

POTTSVILLE, PA.—A charter has recently been granted to the Pottsville & Reading Electric Railway Company, whose line is to extend from Pottsville through the principal towns to Hamburg, thence down the valley and connect with the Reading Traction Company's new line at Temple. At Pottsville the line will also connect with the principal Schuylkill county lines, thus making a complete system.

SAVANNAH, GA.—Judge Falligant denied the petition for the appointment of a receiver for the Electric Railway Company of Savannah, to which we referred recently in these columns, his decision being as follows: "As I regard it, the highest duty of a chancellor is to conserve and not to destroy the interests of property under his jurisdiction. I do not think the facts presented justify me in making what I should consider a remorseless assault upon the credit of this concern. I shall, therefore, decline to grant the prayer of the petition."

WHITE PLAINS, N. Y.—The Highway Commissioners have granted a franchise for an electric railroad which covers the Tarrytown road from Elmsford to White Plains village. Work is to be commenced in sixty days and the road completed within a year. The Moran Company, as reorganized, has the following Board of Directors: James H. Moran, V. A. Krepps, H. T. Montgomery, E. R. Phelps, John Duffy, George L. Miller, Stephen S. C. Smith, J. T. Lockwood, all of White Plains, and S. Webber Parker, of Mamaroneck.

MOUNT VERNON, O.—The Central Ohio Electric Railway Company has been incorporated for the construction and operation of a complete electric railway system between Pittsburg and Chicago. The articles provide for freight, express and passenger traffic, and the hauling of the mails. Among other objects are the supplying of light, heat and power for public and private use, and the construction of telephone and telegraph lines. The headquarters of the company are at Mt. Vernon, and the eastern terminus in Ohio is Brilliant, Jefferson county, and the western Colina, Mercer county. The capital is $100,000, and the incorporators G. A. Jones, F. W. Jones, J. A. Caldwell, Wm. H. Koons and M. Spellacy.

THE FIELD ELECTRIC RAILWAY PATENT.—The recent decision against the claims of S. J. Field for a fundamental street railway patent excited but little attenion and there has been no surprise expressed at the result. The trend of judicial opinion has for some time been noticeably against claims for combinations involving an onerous monopoly, and after the apparent reluctance exhibited in sustaining a patent as strong as the Edison lamp patent, there was but little hope from the courts at any time in recent years for the Field claims. According to the terms of the decision, every part of the combination patented was old and moreover the skill involved in accomplishing the object sought to be thus protected was not such as to involve any exercise of the inventive faculty.

PERSONAL NOTES.

THE ASSOCIATION OF PRACTICAL ELECTRICIANS, Chicago, at its recent meeting adopted appropriate resolutions of regret at the death of Mr. Charles H. Rudd, who was an honorary member of the association.

THE CANADIAN ELECTRICAL ASSOCIATION has been especially happy in the selection of its officers, and to this is probably largely due its rapid growth in importance, which culminated in the recent very successful meeting at Montreal. The formation of the association was generally discussed as early as 1890 and in that year Mr. S. J. Parker, president of the Owen Sound Electric Light & Manufacturing Company, took the first step by obtaining expressions of opinion from leading Canadian electric light men, which were uniformly favorable. The idea was taken up with much vigor by Mr. C. H. Mortimer, the present efficient secretary-treasurer, and finally a meeting for organization was held in Toronto in November, 1891, at which Mr. J. J. Wright, manager of the Toronto Electric Light Company, was elected president, and Mr. C. H. Mortimer secretary-treasurer. At the first annual meeting in June, 1892, both of these gentlemen were re-elected. In 1893 two meetings were held at Toronto—in January and in September—at the latter of which Mr. Wright and Mr. Mortimer were again re-elected to their respective offices. At the recent meeting at Montreal, Mr. K. J. Dunstan, who had served as one of the vice-presidents from the beginning of the association, was elected president, and Mr. Mortimer continued in the position which he has so ably filled during the same per od. Mr. Dunstan is one of the officers of the Canadian Bell Telephone Company, and Mr. Mortimer is the editor of our enterprising contemporary, "Canadian Electrical News," of Toronto. The other officers elected are as follows: First Vice-President, A. B. Smith, Great Northwestern Telegraph Company, Toronto; Second Vice-President, C. B. Powell, Ottawa; Executive Committee, George Black, L. B. McFarlane, T. R. Rosebrugh, E. C. Breithaupt, John Yule, O. Higman, J. W. Taylor, D. A. Star, J. J. Wright and J. A. Kammerer.

K. J. DUNSTAN, PRESIDENT, C. E. A.

C. H. MORTIMER, SECRETARY-TREASURER C. E. A.

Trade and Industrial Notes.

THE ST. LOUIS IRON AND MACHINE WORKS, Main street and Choteau avenue, St. Louis, Mo., are building a 350-hp Corliss engine for the Pekin, Ill., Electric Light Company.

THE H. W. JOHNS MANUFACTURING COMPANY, 87 Maiden Lane, New York, in a 24-page pamphlet gives numerous illustrations of noted buildings, shops, etc., in which its heat insulator and fire protection materials are used. The designs are very neat and furnish almost a complete collection of views of the fine buildings of this country.

THE COLBURN ELECTRIC MANUFACTURING COMPANY, Fitchburg, Mass., has issued a handsome 52-page catalogue containing numerous illustrations of the several types of dynamos and motors manufactured by it, and of accessory apparatus. The catalogue is well arranged and printed, and the numerous cuts render very clear the constructions of the various apparatus.

MESSRS. ROTH & ECK, 30 Market street, Chicago, although their names are yet comparatively new to the electrical fraternity, are rapidly taking that standing which belongs to producers of high grade machines. Both members of the firm are young men, fully competent to undertake all the work entrusted to them. They will make a specialty of manufacturing dynamos from 8 to 100 ights capacity, and of motors from 1/8 to 7-hp.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., will furnish the iron roof trusses for the new city armory, at Pawtucket, R. I. Also the new power house for the Bridgeport Traction Company, at Bridgeport, Conn., consisting of a dynamo room and a boiler room, to be built of iron and brick—composite construction. The dynamo room will be controlled by a traveling crane, furnished by the same firm.

MR. W. A. FENN, of Buffalo, N. Y., for the past three and a half years general manager of the American Electrical Supply Company of that city, has severed his connection with the supply company and is now connected with the Electric Service Company, whose general offices are in the Erie Company's Savings Bank Building, Buffalo. During Mr. Fenn's connection with the Supply Company he has made many friends and has been engaged on some important electric construction work in the state.

THE GENERAL ELECTRIC COMPANY, in a large sized 64-page pamphlet, gives a complete description of its various apparatus for the electrical transmission of power. The new monocyclic system is explained and illustrated, with remarks on its field of application, and many points in regard to multiphased work are brought out. The new forms of generators, rotary and static transformers, synchronizers, etc., bere shown, will be of much interest to the electrician and engineer, who will also find in this pamphlet much technical information that has not yet found its way into text-books or treatises.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., reports the following recent sales: One 50-hp engine direct connected to a Western electric dynamo for Davidson Theatre, of Milwaukee; one 100-hp, and one 75-hp engine, direct connected to Siemens-Halske dynamo, for St. Denis Hotel, New York; one 50-hp direct connected for St. Louis. They have also on the books the following orders received within the last few days: One 100-hp for the Grand Island Light & Power Company, Grand Island, Neb.; one 50-hp for C. F. Rumpp & Sons, Philadelphia, Pa.; one 100-hp for Louisville, New Albany & Chicago Railroad, Chicago; one 40-hp for J. Mason Gross, Wakefield, R. I.

THE GENETT AIR-BRAKE COMPANY, 33 Wall street, New York, will exhibit at the approaching convention in Atlanta, its original air-brake, with various succeeding brakes illustrating the progress made from the start to the perfected and standardized enclosed pump brake. In addition to this, there will be exhibited all the parts in detail of the old style pump and the new style enclosed pump, and two air-brake equipments will be in operation on cars of the Atlanta Consolidated road. One of them will have the Genett testing gauge attached, by which every compression can be noted, and the small amount of power required will be shown. The exhibit will be in charge of the general manager, E. J. Wessels, and Mr. G. S. Lee, the master mechanic of the Genett Company. Mr. Wessels will read a paper on "Power Brakes vs. Hand Brakes" before the convention.

CHAS. E. GREGORY CO., 47 South Jefferson street, Chicago, send us the following list of the sales during the month of September: Home Electric Light & Power Co., Elkhart, Ind., one 50-light American arc dynamo, one 50-light Standard arc machine, 100 C. M. Edison arc lamps, 100 weather hoods, 100 globes; Mrs. S. Livingstone, city, one 1-hp Eddy motor; Eugene Vallens & Co., city, one 1-hp Belding motor; Barrett & Barrett, city, one 2-hp Excelsior motor; Henry Electric Co., Henry, Ill., one 30-light Sperry arc plant complete; O. H. Parker, Anniston, Ala., one 25-hp C. & C. motor; Ford & McGregor, 21 Edison,M. D. arc lamps; F. Braasted, Ishpeming, Mich., one 5-hp Thomson-Houston motor; D. A. & C. A. Goodyear, Tomah, Wis., one 3-hp Jenney motor; Hatch Cutlery Co., Buchanan, Mich., one 25-kw Edison motor; Taylor, Dee & Mack, city, one 2-hp Sprague and one 10-hp U. S. motor; W. Kreilow, Willow Springs, Mo., 4 D., Thompson-Houston arc lamps; Lederrer & Oppenheimer, city, 14 Edison arc lamps; R. Roach, city, one 3-hp Eddy motor; Four Lakes Light & Power Co., Madison, Wis., one 3-hp Jenney and one 3-hp Eddy motor; Crane Elevator Co., one 1-hp Crocker-Wheeler motor; Golz & Sinclair Milwaukee, Wis., one 1-hp Eddy Motor; Racine Dredging Co., Gladstone, Mich., one 3-light Excelsior arc plant; Field Columbian Museum, city, one 45-light Brush arc dynamo and 45 lamps; D. S. Huff, Morris, Ill.,one 1½-kw Edison dynamo; Chicago Turn Gemeinde, city, one 5-hp Excelsior arc motor; Dundee Rapid Transit Co., Elgin, Ill., one 20-hp Sprague motor; Quincy Ploor Plate & Mfg. Co., Quincy, Ill., one 50-light U. S. dynamo; Metropolitan Electric Co.,city,one 7-light Bain dynamo.

Business Notices

Agent · Geo. C. Daniels, Traveling Passenger Agent, 228 Washington street Boston, Mass. F. B. Price, Agent, 32 South Third street Philadelphia, Pa L. S. Brown, General Agent, Passenger Department Washington.

ADDRESSES WANTED.—The following members of the New York Electrical Society, who have made a change of residence, will oblige by sending their new addresses forthwith to the secretary, 5 4 Temple Court, New York City M. W. Grovesteen, D. H. Washburn, J. D. Bishop, James Stewart, C. A. G. Groenbeck, C. D. U. Hobbie, C. G. Curtis, T. A. Sherman, Albert C. Barrett, C. C. Sibley, W. L. Tamblyn, E. S. Reid, C. H. Wright, J. McMahon, A. G. Holcombe, Charles Herman, W. S. Dix, J. A. Cabot, R. A. Mitchell, Thomas Bennett, A. B. Bennett, E. C. Bischoff, W. H. Ripley, J. T. Palmer, M. B. Meddler, E. C. Miller, Alex. Mackinnon, J. H. Longstreet, Herman Wetzler, C. P. Gott, A. S. Miskin, Francis E. Donohue, S. V. Hoffman, W. Schwein, James Callopy, H. T. Salmons, W. B. Heron.

The members of the society are informed that the photograph, taken by flash light, of the visitors to the Wild West Show, is now ready and can be had on application to the photographer, Stacy, 450 Fifth avenue, Brooklyn, price 50 cents.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 25, 1894.

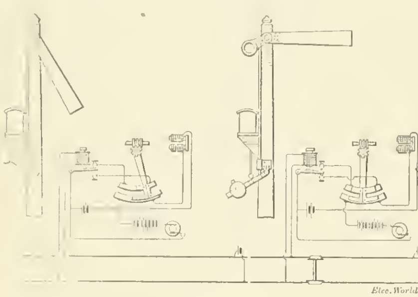
(In charge of Wm. A. Rosenbaum, 117 Times Building, New York.

526,392. CONDUIT FOR ELECTRIC RAILWAYS; D. F. Graham, Springfield, Ohio, and W. P. Allen, Chicago, Ill. Application filed October 25, 1893. This comprises a switching device consisting of a pivoted box with a metallic contact plate therein, a plunger extending through an opening in the box also provided with a contact plate, and a pivoted connection between the plunger and a hinged plate in the conduit.

526,408. BRACKET FOR TROLLEY WIRES; L. S. Pfouts, Canton, Ohio. Application filed December 30, 1893. A pole provided with a fixed right angle arm, provided with a yoke, and a pivoted trolley wire supporting arm.

526,409. TROLLEY AND FEED WIRE BRACKET; L. S. Pfouts, Canton, Ohio. Application filed January 11, 1894. A pole provided with a pivoted supporting arm located at right angles to the trolley wire.

526,414. ELECTRIC SIGNAL APPARATUS; W. W. Salmon, Chicago, Ill. Application filed February 1, 1894. The combination of a motor, a device to be moved thereby operatively connected therewith, a brake circuit for the motor and a separate circuit for the brake, the circuit being provided with



No. 526,414.—Electric Signal Apparatus.

separate sources of energy and being so connected with the moving parts that when they have completed a predetermined movement the motor circuit is de-energized and the brake circuit is energized to retard the moving parts. (See Illustration)

526,415. ELECTRIC SIGNALLING APPARATUS; W. W. Salmon, Chicago, Ill. Application filed February 1, 1894. This comprises an electric motor, an operating circuit and a cushion circuit therefor, and a device to be moved by the motor, the circuits so operatively connected with the moving parts that when they have completed a predetermined movement the cushion circuit is energized to retard the moving parts.

526,422. TROLLEY WIRE HANGER; I. B. Walker, Sioux City, Iowa. Application filed February 26, 1894. A hanger having a central lip between the ends of the hanger, the lip and ends of the hanger being grooved for the reception of the wire.

526,432. MEANS FOR DRIVING DYNAMOS FROM CAR AXLES; W. Biddle, Brooklyn, N. Y. Application filed October 20, 1893. This comprises a transverse girder supported by the truck, suspending links suspended from said girder, bolts connecting the lower ends of the links to the pole pieces of the dynamos, and a connection from the car axle to one pole piece of the dynamo, whereby a constant distance is maintained between the car axle and dynamo.

526,434 JOINT FOR AND METHOD OF JOINING METAL BARS; W. M. Brown, Johnston, Pa. Application filed March 23, 1894. A welding chock adapted to engage the web and flange members of the rail and weld thereto.

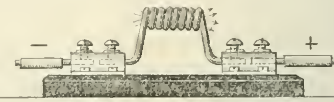
526,468. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; C. D. Tisdale, Boston, Mass. Application filed September 4, 1893. A flexible tube for a conduit having a thickened upper wall and inwardly projecting longitudinal ribs.

426,472. INSULATOR FOR ELECTRIC CONDUCTORS; G. Webster, Philadelphia, Pa. Application filed July 26, 1894. An insulator having a recess in its face, one half of the recess being deeper than the other half, the deepest half forming an indirect channel from one side of the insulator to the other, and means for securing an electric conductor in the channel.

526,487. ELECTRICAL MEASURING INSTRUMENT; H. Herberts, Schenectady, N. Y. Application filed March 5, 1894. This comprises two semi-circular exciting coils connected in parallel, an armature capable of revolving concentrically to the semi-circular exciting coils, a pointer attached to the armature, and a fixed scale indicating the position of the pointer.

526,498 CONDUCTOR SUPPORT AND INSULATOR; D. N. Oysor, Columbus, Ohio. Application filed November 29, 1893. This comprises two separable parts, screw threaded on one end, and an insulating spool adapted to be screwed thereon.

526,502. ELECTRICAL SAFETY FUSE; O. Rau, Milwaukee, Wis. Application



No. 526,502.—Electrical Safety Fuse.

filed October 31, 1893. A fuse constructed with a series of turns or coils lying in close proximity to each other. (See Illustration).

526 549. ATTACHMENT FOR SPEAKING TUBES; W. Weber, Philadelphia, Pa. Application filed December 30, 1893. This consists of a rigid main tube and rigid tubular connections extending on the same side of the same, the extensions being of unequal lengths, the shorter terminating in an ear piece and the longer in a mouth piece.

526,580. TROLLEY FOR ELECTRICAL CONDUCTORS; D. N. Osyor, Columbus, Ohio. Application filed December 6,1893. The combination of a hinged carriage or support, and the wheels carried thereon, of conductor plates in electrical contact therewith, and electrical terminals.

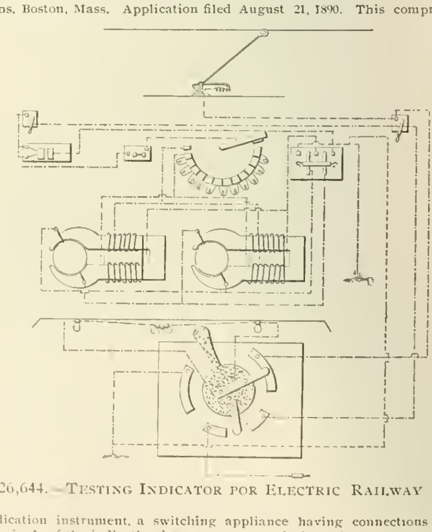
526,583. VOLTAIC REGULATOR FOR DYNAMOS. M. P. Ryder, New York, N. Y. Application filed May 12, 1894. The combination with the regular magnet and swinging armature, of a circuit breaker actuated by the armature and comprising a side plate, a conducting block insulated thereon and conducting springs secured to a stationary support and adapted to contact with the conducting plate.

526,598. ELECTRIC CAB SIGNAL FOR RAILWAYS; E. C. Wiley, Bristol, Tenn. Application filed January 31, 1894. This comprises induced electro-magnets on the car, and approximating electro-magnets arranged along the line; a normally open local circuit and battery for the inducing magnets, having two sets of terminals, one of which is closed through a visual signal, and the other of which is closed by a mechanical circuit closer operated by the passing train.

526,605. RHEOSTAT; B. E. Baker, New Britain, Conn. Application filed June 4, 1894. A rheostat consisting of cores having resistance wires wound around them, blocks of plastic material in which the cores are embedded and suitable clamping devices by which the blocks are retained in operative position.

526,609. SUBMARINE SIGNALLING; L. I. Blake, Lawrence, Kas. Application filed July 6, 1894. This comprises transmitting instruments at a shore station, and an insulated submarine conductor bared to the water at two or more points so as to establish an electrified region of communication, a conductor having its ends immersed at two point of different potentials in the area, and a telephone of low resistance in circuit therewith.

526,644. TESTING INDICATOR FOR ELECTRIC RAILWAY CARS; T. Stebbins, Boston, Mass. Application filed August 21, 1890. This comprises an



No. 526,644.—Testing Indicator for Electric Railway Cars.

indication instrument, a switching appliance having connections to the terminals of the indicating instrument respectively, switch contacts connected with the circuit or apparatus to be tested, and additional switch contacts connected respectively to a movable test plug and to ground. (See Illus.).

The Electrical World.

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CONTENTS.

ACCIDENTS TO FLY WHEELS.

The letter of Mr. T. C. Coykendall which we print elsewhere, advances an explanation for accidents to fly wheels in power houses which is rather novel. The usual cause assigned for such accidents is an increase of speed when the load is thrown off, due to an improperly designed or defective governor. The one offered by Mr. Coykendall is practically the reverse of this, as he ascribes the destructive strain to the load suddenly put on the engine when a circuit breaker, opened by an overload, is again thrown in. In the first case the damage is held to be due to centrifugal action on the wheel, and in the second case to the sudden shock to which it is subjected. As Mr. Coykendall states that several recent accidents to fly wheels which he has investigated can be more readily accounted for on the second assumption than on the first, the matter is one well worth looking into, and we shall be glad to publish the opinions of engineers on the subject.

ELECTRO-CHEMISTRY.

The increasing extent to which electricity is being applied in chemical operations, particularly in Germany, calls attention to the importance of this branch. In the country named and in France, this branch of electrical science is held in high esteem as promising the best field for profitable working, and during the last year or more a number of electro-chemical processes of value have been developed. Among these is the Hermite disinfecting process, which appears to be identical with that now employed by the New York City Government at Rikers Island and elsewhere, and the Digest of this week refers to the electrolytic production of soda, potassic chlorate, sulphuric acid and bleaching material, and to an electrolytic process for the purification of dyes. Those who have followed this section of the Digest will have noted the evidence of the progress in Europe we have referred to, and in which we hope our own country will in the future participate more than it has done in the past.

OVER-COMPOUNDING DYNAMOS IN PARALLEL.

In another column Prof. E. P. Roberts calls attention to a case of over-compounding, where, instead of securing the regulation of voltage desired, the reverse is the case. If two or more dynamos are connected in parallel and each compounded as usual for a certain line loss, the regulation of voltage aimed at will only be attained when all of the machines are kept in circuit. For if the load becomes light and one or more be disconnected, then those still left in circuit will over-compound, not for the current on the line, but for the current in their armatures. If only one machine is left, for instance, and it is heavily loaded, the increase in voltage may be a maximum when it might happen that the load on the line is a minimum, thus subjecting lamps to an abnormal voltage. Two methods are pointed out by means of which this fault may be obviated; one consists in having a multiplicity of exterior circuits independent of each other, which seems to be impracticable; the other necessitates the use of rheostats in the shunt circuit, or, in other words, a double waste of energy, or in both the series coil and in the rheostat. Neither of these methods is satisfactory, and it would seem that in the case considered the best solution would consist in the employment of plain shunt dynamos if there is a large and gradual variation in load.

THE MANAGEMENT OF POWER STATIONS.

The article by Mr. George T. Hanchett under the above caption, now appearing in our columns, will be found to contain information of a decidedly practical character relating to the management of the steam plant of both lighting and power stations. While more and more attention is being paid to the steam department of electri-

cal generating stations, yet the importance of the economies that may be there attained will continue to amply repay the most careful study of the subject. The home-made steam separator illustrated is so cheaply constructed that there can be no excuse left for the station manager to be without this useful adjunct if he has hesitated heretofore on the score of expense. It should be borne in mind that the function of a separator is not only to prevent water from damaging an engine by "pounding" but that it will also effect an economy in the working of the steam in the cylinder. Feed-water heaters are comparatively so inexpensive and the saving to be effected by their use so considerable, that it would be poor economy to rest content with a home-made form like that shown, though even such a makeshift will be much better than none. The lines pointed out in the articles along which possible saving may be made would doubtless, if applied in not a few stations, result in a surprising increaee in income and certainly in a much more satisfactory state of affairs to all concerned.

SYMBOLS AND ABREVIATIONS.

A criticism by Prof. Jamieson, abstracted in the Digest, on the table of "Symbols for Physical Quantities and Abbreviations for Units" printed in the Electrical World, of August 25, is strongly confirmative of the wisdom of the Notation Committee of the Chicago International Electrical Congress, which gave approval to it; for if an unfriendly critic with a rival system can say nothing more damaging we may accept the conclusions embodied in the table to be indeed strongly based. It is true that the system criticized is not theoretically perfect from every point of view, but the aim was not to secure such perfection, which, besides, would have been impossible, but to compile a table that would most probably meet with international acceptance. The criterion to be applied is not, therefore, that of personal opinion; if we are to have an international system we must be willing to meet international views and even make sacrifice to what we may consider unwarranted usages, but yet too firmly fixed to be changed. It is singular that the criticism applied to the use of script letters for magnetic quantities is precisely the one which led to their adoption, which was that they were much more readily written than the bold faced gothic; it was not intended that the exact form of the letter be copied in writing any more than that other script letters are thus imitated. It was supposed that a writer would merely employ the usual script capital, and, to guide the printer, add the necessary direction in the margin in the same way that Greek letters are designated. The use of $\mathcal{L}_s$ and $\mathcal{L}_m$ for self and mutual-inductance, it may be remarked, though not indicated in the table, is not at variance with its plan.

REACTANCE.

The section of Prof. Ryan's article on "Alternate Current Working" in this issue and that which will appear in the succeeding one, will be found of particular interest on account of the very clear manner in which the effects of reactance are explained with reference to practical examples. Of all the electrical words adopted in recent years, this is one of the most useful, for it enables the student to grasp an important conception which, if nameless, would offer more than usual difficulties. The sense in which Prof. Ryan uses the word is that given by those who proposed its use, and in this connection we may note that Prof. Blondel, in the current issue of *L'Industrie Electrique*, vigorously protests against an extension which has been offered to its meaning. In a paper by Messrs. Steinmetz and Bedell, in the Transactions of the American Institute of Electrical Engineers, reactance is defined as equal to the impressed E. M. F. at right angles to the current divided by the current; its application, however, is much extended, in the case of a transformer, for example, to the effect of that part of the back E. M. F., due to the influence of the secondary upon the primary, which is in quadrature with the component in the same direction as the current. Prof. Blondel severely criticises this extension, for, according to it, he says, reactance is no longer a constant of a circuit, but a complex amalgam of all sorts of reactions, leading in some cases to an absurd complication. He concludes that reactance ought, like all other words ending in *ance*, be used only to define a constant of a circuit, and, therefore, should only apply to the effects of inductance and capacity in a circuit. The ground of Prof. Blondel seems to be well taken, and moreover, the sense in which the word was adopted by the American Institute of Electrical Engineers is that which he approves, and does not, therefore, include the extensions referred to and criticised. It is well that this should be understood, for otherwise a most useful term might fall under unwarranted suspicion.

First Aid in Electric Accidents.

Dr. W. S. Hedley in a letter to the London "Lancet," reprinted in the London "Electrical Engineer," gives some rules as to the first aid to be rendered in case of electric accidents, as follows:

(1) Break the circuit at once if there be an interrupter close at hand and you know how to use it; if not, lose no time, but proceed to Rule 2. (2) Do not touch the man's body with your bare hands, but if india rubber gloves are not at hand, pull him off the cable by his coat tail, or fold your coat or some such dry article into two or three thicknesses, and, using this as a pad to take hold of the body, pull it away from the circuit and resort to Rule 5. (3) If unable to get him off, raise with covered hands that part of the body which is touching the earth, or one of the poles of the circuit. This will break the circuit, and it will usually be thus possible to get him easily away, and, if so, proceed to Rule 5. (4) If still unsuccessful, make another pad, and, placing it between the ground and that part of the body in contact with the ground, continue your efforts to detach him. (5) Having pulled him away from the cable, free his neck from clothing, and treat the case as one of drowning, one method being as follows: (6) Open his mouth, and, taking hold of the front part of the tongue with your fingers—covered with a handkerchief if you have one—draw the tongue forward, and gradually let it go back 16 times a minute. Be sure that the root of the tongue is acted upon and drawn forward. If the teeth are clenched and you cannot get them apart with your fingers, gently separate them with the handle of a pocket-knife or by a small piece of wood, cork, etc. (7) Resist the efforts of the bystanders to pour stimulants down his throat until a medical man arrives and "takes over" the case.

New Rule for Current and Lines of Force.

Mr. C. E. Goodrich, in referring to the rule given on page 255 of the Electrical World, April 7th, suggests the following, which he considers better: "The sun appears to travel from east to west and the direction of the current and lines of force is the same." The choice of the best of a large number of rules is to a great extent a matter of taste; each has its disadvantages. For instance, if we understand him correctly, we must imagine the sun as moving some distance below the surface of the earth; then the lines of force observed on the earth (and which must be supposed to return through its axis, thus encircling the current) have the same direction as if the apparent motion ot the sun were a current. But, if we imagine the sun above us, where it really is, the direction will be wrong. Furthermore, we must remember that the geographical north pole of the earth would, in a laboratory, be marked the south pole, but if we limit ourselves to the direction of a compass needle, this discrepancy need not trouble us, provided we forget all about the geographical north pole and consider only the lines of force around us.

A Simple Rule.

A very simple rule, which may be new to some, for remembering the relative directions of the lines of force encircling a wire and the current producing them, is as follows:

If the circular direction of motion of a nut on a bolt represents the lines of force around the bolt, then the direction of the current which produces them will be that in which the nut travels along the bolt, assuming, of course, the usual right-handed screw thread.

A Wise Admission.

There is a very true saying to the effect that the more a man knows the more he knows how little he knows, which applies to a recent remark in our esteemed London contemporary "The Electrician." In referring to the expression "in contact with electricity" used by a correspondent, the editorial adds "we know nothing about 'electricity'; the word is very rarely used except by accident in the editorial columns of 'The Electrician.'"

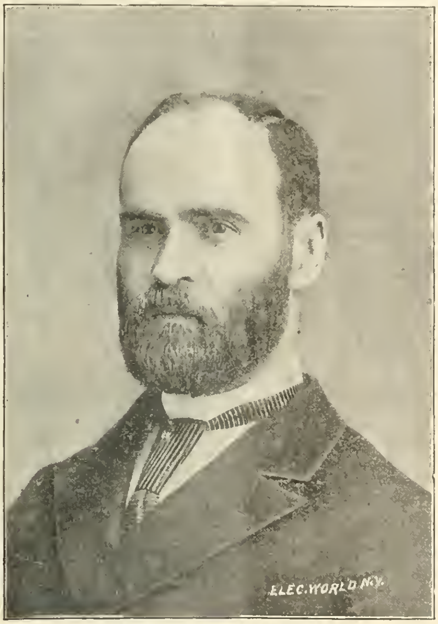
Alexander Macfarlane.

Alexander Macfarlane was born at Blairgowrie, Scotland, April 21st, 1851. He was educated at the public school, where at the age of 13, he became a pupil-teacher. At 18, having finished his apprenticeship as a teacher and saved a little money, he entered the University of Edinburgh. There he first distinguished himself in the study of the classics, and by his eminence in that line won money-prizes sufficient to carry him through an extensive undergraduate course. Though he was urged to study for honors in classics, he preferred to devote special attention to logic and philosophy; but becoming convinced that logic needed an infusion of mathematical and scientific ideas, he took up the study of mathematics and physics with the desire to gain a clear knowledge of their principles.

In 1875 he graduated master of arts with the highest honors in mathematics and physics, and was immediately appointed an instructor in physics by Professor Tait. With the advice and encouragement of that celebrated physicist he made a quantitative investigation of the conditions governing the electric spark, and at the same time pursued the necessary studies for the degree of Doctor of Science in Physics and Mathematics. He obtained that degree in 1878 and was immediately elected a Fellow of the Royal Society of Edinburgh.

His electrical researches came under the notice of Clerk Maxwell, who made suggestions for their extension. He next (1879) published his views on logic in a volume entitled "Principles of the Algebra of Logic," which with subsequent papers on the "Analysis of Relationships" have taken a permanent place in the history of the science. In 1881 he was appointed Mathematical Examiner at the University of Edinburgh; while holding that appointment he prepared the volume on "Physical Arithmetic" (1885). the express object of which is to elucidate the logical processes involved in the application of arithmetic to physical problems.

In 1885 he was called to the chair of physics in the University of Texas, which position he has recently resigned. During the nine years spent there he built up a fine physical department, and accomplished a large amount of research work, for this purpose spending his vacations at the great universities of the North. He prepared an extensive series of mathematical tables on a uniform plan (1889), he added to the research on the electric discharge, and after long reading and study published his views on the subject of space-analysis In carrying out this research he devised a series of models, the earlier specimens of which received an award at the Columbian Exposition.



ALEXANDER MACFARLANE.

In 1887 he received the honorary degree of LL.D. from the University of Michigan; he is a member of the American Institute of Electrical Engineers and a corresponding member of several foreign scientific societies. As honorary secretary of the Texas Academy of Science he was successful in laying the foundations of a flourishing society.

Personally Dr. Macfarlane is a characteristic Scotsman, sturdy, persevering, with a relish for hard work, thoughtful, courageous in his convictions, and critical of the statements not only of others but of himself also.

His memoirs may be classified under three heads, viz.: Experimental and electrical, space analysis, logico-mathematical.

Under the first head comes his doctor's thesis "On the Disruptive Discharge of Electricity" published in the Transactions of the Royal Society of Edinburgh for 1878. In this paper it was for the first time shown that for pressures less than an atmosphere and greater than 2 mm, the connection between the difference of potential required for a spark and the pressure of the air is given by a branch of a hyperbola, the real axis of which corresponds to the pressures and the imaginary axis to differences of potential. He also showed that so long as the distance between two parallel plates is small, the difference of potential for a spark depends in the same manner upon the distance between the plates. This paper was followed by a number of others on closely related subjects; namely: "On the Discharge of Electricity Through Oil of Turpentine," Trans. R. S. E., 1878; "On the Disruptive Discharge of Electricity," Part II., Trans. R. S. E., 1878, Part III., 1879; "On the Discharge of Electricity," Phil. Mag., 1880; "Discharge of Electricity Through Colza Oil and Other Liquids," B. A. Report, 1881; "Positive and Negative Electric Discharge," Proc. R. S. E., 1880; "Effect of Flame on the Electric Discharge," Proc. R. S. E., 1882; "Arrangement of the Metals in an Electro-frictional Scale," Proc. R. S. E., 1884; "On the Electric Strength of Solid, Liquid, and Gaseous Dielectrics," Physical Review, 1893. In these papers it was shown for the first time that in the case of a liquid dielectric the difference of potential required for a spark is proportional to the distance between the parallel plates. He also found that for a given length of spark between a ball and a disc the potential difference between the electrodes was smaller when the ball was positive than when it was negative.

Dr. Macfarlane is very widely known both in this country and in Europe, because of his work in space-analysis. So long ago as 1883 he communicated to the Royal Society of Edinburgh a "Note on Plane Algebra," which stated briefly the view he had arrived at concerning the imaginary algebra of the plane. Starting from the "Analysis of Relationships" he had independently re-discovered the principles of Argand's method, and this gave him a point of advantage from which to study Quaternions and the more general problem of the algebra of space. He has now published five papers, viz.: "Principles of the Algebra of Physics," (1891), "The Imaginary of Algebra" (1892), "The Fundamental Theorems of Analysis Generalized for Space" (1892), "On the Definition of the Trigonometric Functions" (1893), "The Principles of Elliptic and Hyperbolic Analysis" (1893).

The object of the "Principles" is to found an analysis which will harmonize and unify Quaternions, Grassman's method, and Determinants, and apply directly to physical quantities in space. It is called the algebra of physics because it deals with the ideas of mass and time as well as the idea of space. The methods of Hamilton and Grassmann are harmonized and unified, but it is a mistake to suppose that they are identified; according to Macfarlane's view they are complementary to one another. One part of space analysis deals with the product functions of line-vectors, another part with the composition of versors, that is, of area-vectors, or angles in the most general sense; the *Ausdehnungslehre* is a fragment of the former, *Quaternions* of the latter. In the paper on "Fundamental Theorems," the principles of spherical trigonometrical analysis are established, and the key to the whole development lies in the discovery of the Exponential Theorem for the sphere. The remaining two papers take up the composition of elliptic and hyperbolic angles, and lay the foundations of the more general trigonometry of the ellipsoid and hyperboloid. A paper "On the Analytical treatment of Alternating Currents" read at the International Congress at Chicago, another "On Physical Addition or Composition" read before the A. A. A. S. at Madison, show the power of the analysis when applied to a special problem.

His mathematical papers are numerous and varied, but they all bear the impress of a logician. The more important are: "An Analysis of Relationships," 1881; "Analysis of Relationships," Applied to Various Problems," 1882; "On Voting," 1884; "The Logical Spectrum," 1885; "The Fundamental Rules of Algebra;" "On Exact Analysis as the Basis of Language," 1892. At the meeting of the American Mathematical Society recently held in Brooklyn he read a paper "On the Fundamental Laws of Algebra," in which he advocated a real, not a formal, basis for the science.

Relation Between Line Wire Losses and the Over Compounding of Dynamos.

BY E. P. ROBERTS.

The sizes of the conductors in a multiple arc system are calculated on the basis of a certain percentage of loss in the conductors at some definite load. The loss in the line increases from zero at no load to the designed percentage at full load. Therefore the potential difference (P. D.) at the station must increase at the same ratio.

The over-compounding of dynamos is intended to automatically maintain a constant P. D. at the translating devices, or at some central point in the system, analogous to the center of gravity of a body.

If the system is for 110 volts and 10 volts loss at full load (not necessarily estimated for simultaneous use of all the translating devices connected in circuit) then, at 10 per cent. load 111 volts is needed at the station, at 15 per cent. load, 115 volts, and at full load, 120 volts.

The compounding and connecting up of the dynamos to the circuits is designed in accordance with one of three plans:

Case 1.—Over-compounding each dynamo in the same ratio as the line loss. If there is a 5 per cent. loss in line, over-compound 5 per cent. (a) If only one dynamo is used and it have a capacity equal to the full load estimated for the line, the voltage will rise in the proper ratio of P. D., at the dynamo terminals, to current output. (b) If, however, more than one dynamo be used and each dynamo be over-compounded in the same ratio as the line loss and the dynamos be connected in multiple when desired, the design is incorrect. It is to call attention to the above fact, and to the degree of loss resulting from the same, that this article is written.

Case 2.—The wiring is divided into a number of circuits and the dynamos are over-compounded in the same ratio as the line loss, and when more than one dynamo is needed the circuits are divided, a portion being thrown on to each dynamo in operation, each dynamo and its circuit being entirely independent of all others. This method is correct in principle.

Case 3.—The series windings of all dynamos are permanently connected in parallel by an equalizing wire and the result is that each dynamo, when operating singly, only increases the P. D. at its terminals to the proper amount, which depends upon what percentage its total output is of the total line load. As more dynamos are added the current increases in the series windings and with consequent increase of P. D. This method also is theoretically correct.

The P. D. at the dynamo is often termed the E. M. F. of the same. It is sometimes convenient to consider it as such, although the E. M. F. properly includes besides the P. D. at the binding posts, the P. D. lost inside the dynamo.

Case 1, (b) This, as before stated, is the special object of criticism. If the designer of an electric light plant for incandescent lamps specifies that the wiring for a certain load must be so proportioned that there will not exist, at such a load, between any two lamps a difference of more than two volts and he then introduces conditions resulting in a total variation, under varying conditions of load, of four volts, he is, to put it mildly, inconsistent.

When a designer specifies the clause above stated and then adds that the dynamos must be operative in parallel and does not design for Case 3, he is open to the above charge, and, if he accepts the plant, his test is open to adverse criticism.

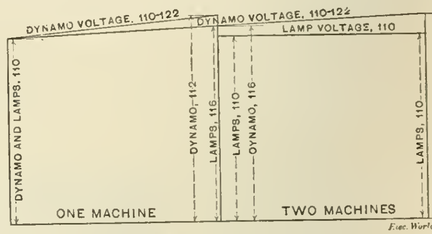
If the plant be designed for a certain wire loss and each dynamo be over-compounded to the same degree, then, at full load, and all dynamos working together, the desired P. D. is obtained, and if they all remain in operation until the highest load is reached, the desired P. D. will be retained, with more or less constancy, at the lamps; but if, when the load becomes sufficiently small for any one dynamo to carry it all, and such dynamo then be thrown off, the loaded dynamo will then give its maximum P. D.; but as the line is lightly loaded, the line loss will be less than at the maximum load and the P. D. at the lamps will rise to a degree depending upon the ratio of full load of dynamo to full station load. If the line loss at the maximum load be considerable and any dynamo unit be a small fraction of the maximum station load, the resulting increase of P. D. may be very considerable. Even if such be not the case the resulting decreased life of the lamps, and especially the decreased efficiency during the life, may be well worth considering.

For example, consider a plant of 2,400 maximum load, 110 volts lamps and 5 per cent. line loss, the dynamos to be over-compounded for 5 per cent. and to operate in parallel at full load. If one dynamo be a 250-light machine, for day and late night load, and operates by itself an average of 200 lights for 10 hours of the 24 for 300 days per annum, the result will be about 114.5 volts at the lamps, (115 at the dynamo) for such time as 200 lights are used, and this will materially affect the life, reducing it possibly one-half. The direct result in loss of money for lamps would therefore be, on an average life of 800 hours, and cost in place of 35 cents.

$$\frac{200\ (\text{lamps}) \times 10\ (\text{hours}) \times 300\ (\text{days})}{800\ (\text{hours})} = 750 \text{ lamps,}$$

and, as the life is cut in half, 750 lamps in additional will be needed, which, at 35 cents amounts to $262.50 per year. It is true this is not a large amount, but it is well worth saving. It is less than the actual loss, as it represents only lamp expense and, as before stated, the efficiency is reduced even more rapidly than the life.

Large isolated plants are not uncommonly designed with 10 per cent. line loss and, in such a case, the evil would be increased four-fold, or more, under the same general conditions. In a 110 volt plant having two dynamos, of equal capacity, the following diagram represents the conditions with 10 per cent. line loss.



Showing Relation of Voltages.

The straining is usually aggravated by the fact that the lights on all branches are not turned on and off in the same ratio and therefore one or more circuits must necessarily receive more P. D. Therefore, having such a plant, the circuit should be arranged as in Case 2, or hand rheostats should be inserted in the shunt windings of the dynamos, and the P. D. regulated by hand, either in accordance with a voltmeter indicating from one or more centres of distribution, or by increasing the P. D. in the ratio of the line loss to the current flowing, as indicated by an ammeter and by a voltmeter connected at the station end of the mains.

A Peculiar Phenomenon.

BY W. W. VINCENT.

A note on "A Peculiar Phenomenon" in the Electrical World of Sept. 15, recalls an experience somewhat similar to the one mentioned, though its cause may be more easily explained. A short telephone line running southeast and northwest had an ordinary extension bell at its southern end and a battery of three cells; at the northern end was a magneto relay and local battery and bell. The battery at the southern end was set up some two months ago and so connected that its E. M. F. was in the same direction as that of an earth current which was found to exist. Sheet iron plates having an area of 4 square feet each were used at each end.

The first heavy thunder storm since putting up the line occurred on Sunday, Sept. 16, when the line refused to work. On testing with the transmitter battery and a galvanometer in circuit, the E. M. F. of the earth current was found to have changed sign and was consequently in opposition to the E. M. F. of the cells. The transmitter cell was then placed in the circuit with the same polarity as that of the earth current, with the result that a call was established at the other end of the line. The battery of three cells was again tried but refused to work until connections were reversed. A few days later on the approach of a similar storm the relay, which has a resistance of 20 ohms and is not very delicately adjusted, had to be disconnected to prevent the local bell from running continuously. Such a strong earth current over a line of less than one mile in length appears to be somewhat remarkable.

Progress and Simplification.

One of our English contemporaries differs from Herbert Spencer when it remarks that progress means simplification, and that "unless we get this we have not advanced a step, shuffle the cards as you may."

Copper Production.

According to some recently published statistics the United States produces nearly as much copper as all of the rest of the world together.

Notes on the Management of Railway Power Stations—II.

BY GEORGE T. HANCHETT.

THE STEAM FITTING.

The pipe line appears at first sight so small a portion of the anatomy of a power-station that to devote much space to it in such general notes as these seems sbsurd. The importance of the pipe line is nevertheless great, and the proper performance of its function is so necessary to general economy that it cannot be neglected. The average station engineer sometimes has to install or repair a line of steam pipe and a few hints as to its construction and its losses may be useful. The loss to be dreaded most is the loss of heat from radiation. The necessity of thoroughly protecting steam pipes by non-conducting coverings is so great that the best covering the market affords is none too good. The following problem, solved by a rule given by a competent authority, will show better than words the necessity of careful attention to this matter. Suppose we have an uncovered steam pipe of 6″ standard and 60 feet long conveying steam at a pressure of 90 lbs. How many horse power are lost by radiation, the temperature of air being 80 degree F.? The heating area of 60 feet of 6″ standard pipe is practically 104 square feet. The temperature of saturated steam at 90 lbs. gauge is 331 degrees F. .058 is an empirical constant. The heat units lost per minute are $(331°—80) \times 104 \times .058 = 1514$. nearly. Assuming the mechanical equivalent of heat 778 the horse power lost is

$$\frac{1514 \times 778}{33{,}000} = 35.7\text{-hp.}$$

This figure is rather startling and the more so when we realize that at 90 lbs. pressure a six inch-pipe is none too large for a 130-horse power engine, and that if such a pipe line as this just discussed were used, about 27½ per cent. of the energy would be lost. Moreover the energy that is lost is the very energy of the steam that the engine is able to utilize. The engine cannot operate economically on steam laden with moisture and robbed in a great part of the heat equivalent of external work. It is hardly necessary to say that the exposed portions of the boiler need to be well protected also. Moist steam may be avoided in a great measure by the use of a separator, and the station superintendent should insist on having one where the pipe line is at all long. There are many good types of separators on the market, all of which are of more or less value. Fig. 2 shows a form of separator which may be made out of steam

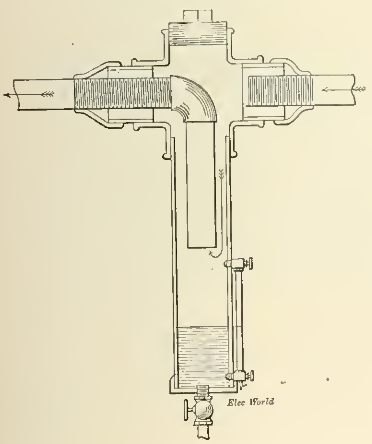
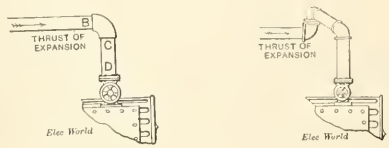


FIG. 2.—STEAM SEPARATOR.

fittings with a little labor and patience. It may be drained automatically by a steam trap, or a glass gauge and cock may be used as shown. A separator should be placed as near the engine as possible and both pipes should incline toward it in order that the condensation shall drain into the separator. A separator is useful in that it momentarily intercepts the water from a foaming boiler. With a little experience and experiment it is very easy to detect wet, dry, and superheated steam by simply observing it as it issues from an orifice. Superheated steam will not be visible till it has issued a considerable distance from the orifice, an inch or even more. Dry steam will be faintly visible at the orifice and gradually increase in its cloudy whiteness as it proceeds on. Steam with a small percentage of moisture, 1 to 2 per cent., will appear quite white at the orifice and will increase in its capacity but little as it proceeds. Steam from a foaming boiler will appear a dense white at the orifice and will often be accompanied by a sputtering sound similar to that of blowing off a gauge cock at or near the water line. The importance of dry steam in the economy of the engine will be shown later on. The water in steam pipes is not only prejudicial to the safety of the engine, but to the pipes themselves. If steam is turned into a pipe containing water the latter is thrown violently against the sides of the pipe producing the "ramming" or "water hammer" which is liable to burst the pipe. Hence it is important to have a system of steam pipes efficiently drained on its own account. For this reason a steam pipe should not drain into the boiler, especially if it be a long one. The steam meeting the reversed current of water may do serious damage to the pipe by ramming.

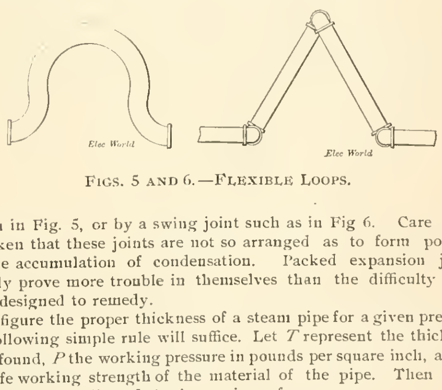
Unless steam pipes are installed with due care expansion will prove a serious source of trouble. By exercising a little ingenuity in the jointing of the pipes the effect of the expansion may be made to simply turn the pipe in its fittings and not break it off close thereto. An iron steam pipe 40 feet long and raised 300 degrees above the atmosphere will expand about an inch. If connected to



FIGS. 3 AND 4.—PIPE CONNECTIONS.

an engine as shown in Fig. 3 the pipe will be broken off short at B, C, or D, while if connected as in Fig. 4 this difficulty will be avoided.

Long lines of pipe may be relieved from the effects of expansion by the introduction of a flexible spring loop of iron pipe bent as



FIGS. 5 AND 6.—FLEXIBLE LOOPS.

shown in Fig. 5, or by a swing joint such as in Fig 6. Care must be taken that these joints are not so arranged as to form pockets for the accumulation of condensation. Packed expansion joints usually prove more trouble in themselves than the difficulty they were designed to remedy.

To figure the proper thickness of a steam pipe for a given pressure the following simple rule will suffice. Let T represent the thickness to be found, P the working pressure in pounds per square inch, and F the safe working strength of the material of the pipe. Then if R represents the radius of the inner circumference

$$T = \frac{P\,R}{F} + C,$$

where C is a certain constant given in the table beyond. If the pipe were subjected to internal pressure only and was not liable to mechanical strains from without this constant could be neglected. The value of F should be carfully chosen. It is obtained by dividing the breaking stress by a factor of safety, and the more a pipe is subjected to alternate heating and cooling or to the water hammer the larger this factor should be.

Material.	Ultimate Resistance to Tension.	F. With factors of safety, 4	5	6	C.
Wrought Iron....	48,000	12,000	9,600	8,000	.12
Cast Iron..........	20,000	5,000	4,000	3,333	.45
Copper............	30,000	7,500	6,000	5,000	.125
Lead..............	3,300	825	660	550	.18
Zinc................	7,500	1,875	1,500	1,250	.16

The constants in the column C are chosen from purely practical

considerations. 0.12 for wrought iron is chosen because a wrought iron pipe over 1 in. in diameter needs at least .12 in. of thickness to give it sufficient strength to cut threads on it and resist mechanical stresses. .45 for cast iron was chosen because it is not possible to cast well and at the same time cheaply thinner pipes. Similar considerations have governed the choice of other constants.

Copper pipes with brazed seams are of uncertain strength. It is well to remember also that copper loses 15 per cent. of its tensile strength at 360 F. and as this is the temperature of steam at 177 lbs. gauge approximately it is a serious consideration.

The proper size of a steam pipe for an engine may be found by the following rule:

$$a = \frac{A\,S}{s}$$

where a = the desired pipe area, A = the area of the piston in square inches, S = the piston speed in feet per minute, and s = the velocity of the steam in the pipe in feet per minute. With straight, short runs of pipe s may be as high as 6,500. When the steam pipe is of ordinary length and with three or more bends 5,000 is of good value. Thus a McIntosh and Seymore engine 16x17 has a piston speed of 680 feet per minute; what is the proper size of steam pipe under ordinary circumstances?

$$\frac{\left(\frac{16}{2}\right)^2 \times 3.1416 \times 680}{5{,}000} = 27.34 \text{ nearly,}$$

and the diameter of a circle with 27.34 area is 5.9 inches, and the nearest standard size is 6″ the one used by the manufacturers.

The safety valve of a boiler is one of its most important adjuncts. It should be lifted every day to be sure it does not stick, and once a week at least the pressure should be raised so that it will blow off. The gauge pressure should be noted at this time and should agree with that for which the safety valve is set. If it does not, either the gauge or the valve is wrong and should be corrected. Two small safety valves are better than one large one.

The steam gauge on the ordinary boiler is of the Bourdon type. They work on the principle that a bent tube tends to straighten itself under internal pressure. This tube is of bronze or composition and will have its elastic properties changed if exposed to high temperatures. It is therefore necessary to prevent live steam from entering the gauge by interposing a pipe bent in a syphon shape so as to always contain water.

Glass gauges to indicate the height of the water should be frequently blown out as they are apt to become plugged up and hence unreliable. The test cocks should be frequently used to check its accuracy.

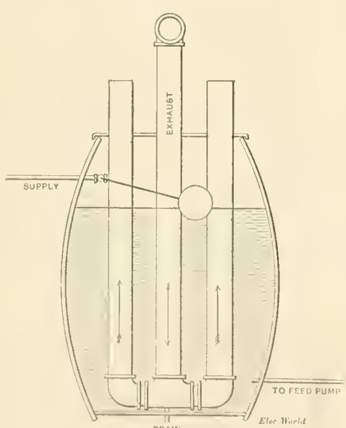


Fig. 7.—Feed Water Heater.

Never allow the exhaust steam from an engine to exhaust directly into the air. If the management will not supply a feed water heater, one may be made from a barrel or hogshead as shown in Fig. 7. It should be covered carefully to exclude any oil from the exhaust. Such an arrangement will tend to eliminate a noisy exhaust which otherwise would be a source of complaint, and although by no means perfect, will effect a saving far in advance of its cost and maintainance.

(To be continued).

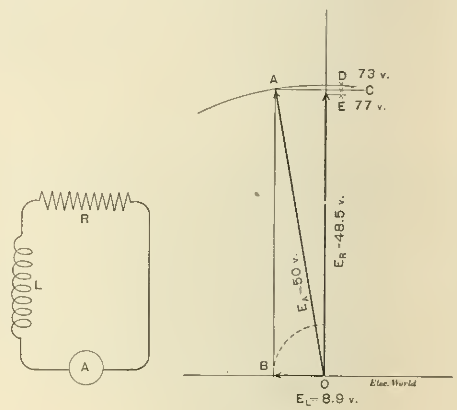
Alternate Current Working—VI.

BY HARRIS J. RYAN.

The American Institute of Electrical Engineers at a general meeting held in May, 1894, adopted at the suggestion of Messrs. Steinmetz and Bedell the term "reactance" to be equal to the component of the impressed E. M. F. at right angles to the current divided by the current. Stated in another way: Reactance equals the volts per ampere produced by self-induction or capacity. The reader is referred to a most instructive paper on "Reactance" by Messrs. Steinmetz and Bedell in The Electrical World, June 30, 1894, page 862. Reactance is a convenient term, and its use is illustrated in the following examples.

The American Institute of Electrical Engineers has also adopted the term "inductance" to be synonomous with coefficient of self-induction. Inductance is more acceptable because more convenient.

The diagrams of Fig. 18 illustrate one of the most common problems and its solution that is met with in alternate current working. We have a source of alternate current pressure at



Figs. 18 and 19.

A_1 = 50 volts at 125 p. p. s. R is a non-inductive load on a circuit of 100 incandescent lamps, and has a working resistance of .5 ohms. Appreciable induction is introduced into the circuit by the current through the motor meter at L. The induction produced in the balance of the circuit is negligible. The inductance at L, .000118 henrys, was determined in the following manner: An alternating current of 150 amperes at 125 p. p. s. was passed through the meter, and the alternating difference of potential between the terminals of the meter was observed on an alternating voltmeter and found to be 14 volts. The ohmic resistance of the meter from terminal to terminal is .008 ohms. The impedance of the meter then is

$$\text{Impedance} = \sqrt{R^2 + \omega^2 L^2} = \frac{E}{C}$$

$$= \sqrt{.008^2 + 785^2 L^2} = \frac{14}{150}$$

from which is determined the value

$$L = .000118 \text{ henrys.}$$

In this case for the determination of the inductance at L we might have neglected the ohmic resistance of the meter without sensibly affecting the result. There are many cases, however, where one cannot neglect the internal ohmic resistance of the apparatus or machinery in making such a determination. Under these circumstances then we know the values of the impressed E. M. F. resistance and inductance of the circuit ALR, and we want to deduce the current that will be established and the pressure that will be maintained through the lamps at R. The current may be determined from the relation

$$C = \frac{E}{\text{Impedance}}.$$

$$C = \frac{50}{\sqrt{[.5 + .008]^2 + (.00118 \times 2\pi\, 125)^2}} = 97 \text{ amperes,}$$

the pressure maintained on the lamps is

$$E_R = 97. \times .5 = 48.5 \text{ volts.}$$

The fall of potential through the meter due to ohmic resistance is

$$C R = 97 \times .008 = .776 \text{ volts.}$$

The E. M. F. of induction reactance in the meter is

$$E_L = C L'' \omega = 97 \times .000118 \times 2 \pi \times 125 = 8.9 \text{ volts.}$$

The total drop between A and $R = 50 - 48.5 = 1.5$ volts. Of this 1.5 volts, .776 has been accounted for by the ohmic resistance of the meter leaving a balance of $1.5 - .776 = .724$, which is the amount by which E_A is lessened by the counter action of the 8.9

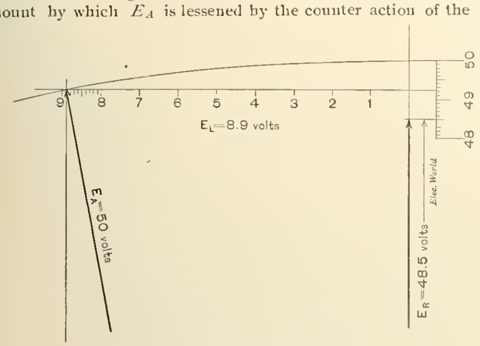
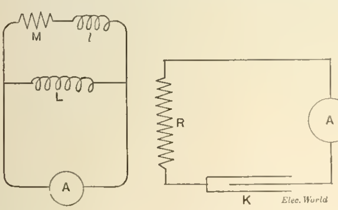


FIG. 20.

volts produced by the induction in the meter. In Fig. 19 these relations are expressed graphically. A distance AO is laid off on the vertical scale equal to the impressed E. M. F. or pressure of the alternator. The result of all falls of potential and induction E. M. F.'s in this circuit must be equal to this amount, just as in mechanics action and reaction are always equal. With O as a centre a circle is laid off, whose radius $O B = E_L = 8.9$ volts. On the left of this circle a tangent is drawn that passes through A. AB has a value of 90 degrees behind OB such that when they are combined OA will result. AB is, therefore, the value of the E. M. F. that is applied against the ohmic resistance of the circuit in establishing current. AB is equal to the product of the total ohmic resistance of the circuit into the established current. By completing the parallelogram of the E. M. F.'s we will get the exact time position of the three principal values E_A, E_R and E_L. $E_A = OA$, $E_L = OB$ and $E_R = OC$.

It is noted that E_L is in advance of E_A, and E_R is behind E_A. The current is always in unison with E_R so that it is likewise behind E_R, which has an important meaning when we come to the determination of power. The top of Fig. 19 is enlarged in Fig. 20 and the results may be read graphically direct from the figure.

Problem 2 (see Fig. 21), illustrates a case that occurs in practice where induction motors are used. A is an alternator furnishing current at a pressure of 1,000 volts and 125 p. p. s. This alternator furnishes current to an unloaded and a loaded induction motor. L is the circuit through the unloaded, and RL through the loaded motor. Ten amperes pass through the loaded motor at L, and may be called the induction current. The motor has so low an ohmic resistance that the falls of potential thus produced may, for our present purposes, be neglected. The instant that the motor terminals are



FIGS. 21 AND 23.

attached to the leads from the alternator, current is set up through the motor in such an amount that a sufficient alternating magnetization or induction takes place to produce a pressure in the motor conductors that is equal and opposite to that of the leads. This induction must be 90 degrees behind the alternator pressure and the induction current will, therefore, be 90 degrees behind that pressure. The motor that does work will take from the line in addition to this induction current a current that is in unison with its counter E. M. F. Induction motors are designed as far as practicable so as to have induction occur only in the circuits directly concerned with the development of mechanical power. This result is never entirely obtained, so that the circuit of the loaded motor acts as though that part of it were ohmic resistance and the balance self-induction. The self-induction part is represented by $l = .03$ henrys. We want to know the total current that the alternator must furnish, and the motor E. M. F., working current and induction current that the loaded motor will use at a total current of 15 amperes. The 15 amperes will produce a self-induction E. M. F. in the motor of $C l \omega = 15 \times .03 \times 2\pi \times 125. = 350$ volts. A current of 10 amperes through the motor when running light produces an E. M. F. of 1,000 volts equal and opposite to that of the line. Part of this is due to L, and amounts to $CL\omega = 10 \times .03 \times 2\pi \times 125 = 236.$ volts. The balance, $1000 - 236 = 764$, is due to induction through the conductors, that transform their electrical energy into mechanical power. These 764 volts are the motor E. M. F. of the motor when running light. We then have 764 volts of motor E. M. F. per 10 amperes of induction current. Every ampere of induction current will produce 7.64 volts of motor E. M. F.

In Fig. 22 line OD expresses this relation. The arc IBJ is laid off with a radius of 15 amperes, the total motor current; HK, with a radius of 350 volts, the self-induction E. M. F. of the motor; and FG with a radius of 1000 volts which is the pressure of the leads. To start the diagram that will produce the solution of our problem we select a point at E somewhat below the no load motor E. M. F. of 764 volts. A horizontal is then drawn to D, a perpendicular to A, and from the intersection of the arc at B, OB is drawn. This is the time position of the total motor current of 15 amperes. OA equals 9.7 amperes, the induction current. At right angles to OB, OH is drawn giving the time position $El = 350$ volts. From H a vertical is drawn to an intersection of FG at F. From F a parallel to OH is drawn to an intersection with OG at E. $OE =$

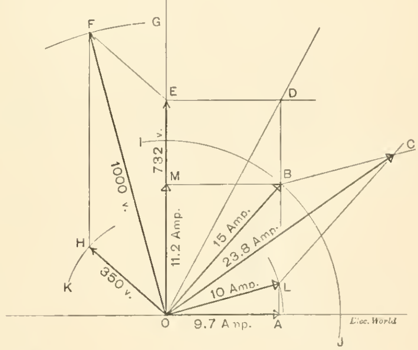


FIG. 22.

732 volts, is the desired working motor E. M. F. In general this intersection of OG will not occur quite at E, and the position of E is adjusted until the two coincide when the diagram is accurate and the solution complete. To know the total current that the alternator will furnish to the motors we must add the induction current of 10 amperes of the motor that is running light to the total current of 15 amperes of the working motor. To do this $OL = 10$ amperes is laid off one-quarter period behind the impressed E. M. F., OF. The parallelogram defined by OL and OB is completed and we obtain the diagonal $OC = 23.8$ amperes as the total current that the alternator must furnish.

(To be continued.)

Three-Phase Motors in Switzerland.

From some interesting statistics just published it appears that out of 99 motors installed in the year 1893 in Switzerland, 41 were for three-phase currents, 23 for single phase and 4 for two-phase currents and 31 for continuous currents.

Development of Industrial Instruction in America.

A French writer on this subject says in an electrical contemporary that Frenchmen agree that Americans have an initiatory spirit compared with which that in France cuts a sad figure.

Electrodynamic Machinery—XI.

BY E. J. HOUSTEN AND A. E. KENNELLY.

50. The specific reluctance of iron, that is, the reluctance of unit volume measured between parallel faces, is called its *reluctivity*. The reluctivity of air-pump vacuum is unity; the reluctivity of air, wood or glass, etc., is practically the same. The reluctivity of iron may be as low as 0.0005, but varies with the flux density. That is to say, the reluctance of a cubic centimetre of iron, measured between parallel faces, may be as low as 0.0005 oersted.

51. The fact has been established by observation, that in the magnetic metals, within the limits of observational error, a linear relation exists between reluctivity and magnetizing force. That is to say, within certain limits, as the magnetizing force brought to bear upon a magnetic metal increases, the apparent reluctivity of the metal increases in direct proportion. Thus, taking the case of soft Norway iron, its reluctivity, at a magnetizing force or prime magnetic intensity of 4 gausses, may be stated as 0.0005. Increasing the magnetizing force, the reluctivity increases by 0.000057 per gauss, and this increase, plotted graphically, would be represented by a straight line.

52. The accompanying curve sheet represents the results of acual observations by different observers upon different samples of soft, wrought iron and cast iron. It will be seen that in the early stages of magnetization, below a critical magnetizing force, which varies with different samples from 1 to, perhaps, 15 gausses, (the latter in the case of cast iron), the reluctivity decreases with an increase in magnetizing force; but, when the critical magnetizing force is reached, the direction of the curve changes and the value becomes linear. Strictly speaking the linear relation of reluctivity and magnetizing force, represented in the figure, is true only for the apparent reluctivity of the metal itself, and is irrespective of the ether which pervades the metal; for, were this relation strictly linear for all values of the magnetizing force beyond the critical value, then the reluctivity would become infinite with an infinite magnetizing force; whereas, by observation, the reluctivity of the most highly saturated iron never exceeds unity, that of the air pump vacuum, or approximately that of air. In point of fact we may consider the magnetism as being conducted through two paths in multiple arc; namely, that of the magnetic metal proper, and that of the ether permeating the metal. The first path may be called the *ferric path of metallic reluctivity*, and has a reluctance varying from a minimum at the critical magnetizing force, up to infinity, by the linear relation. The second path is the *ether path of reluctivity*, and is generally assumed to have a constant reluctivity of unity. The joint reluctivity of the two paths will be $\frac{1 \times \nu}{1 + \nu} = \frac{\nu}{1 + \nu}$ where ν, equals the reluctivity of the ferric path. Since in actual dynamo machinery the value of the magnetizing force is never much more than 80 gausses, the above consideration is of small practical importance, since ν is always much less than unity, say 0.01, and the discrepancy introduced by taking account of the multiple connected ether path, is only the difference between 0.01 and $\frac{0.01}{1 + 0.01} = \frac{0.01}{1.01}$ or about 1 per cent., so that, for all practical purposes, we may assume that the metallic reluctivity is the actual reluctivity of the iron.

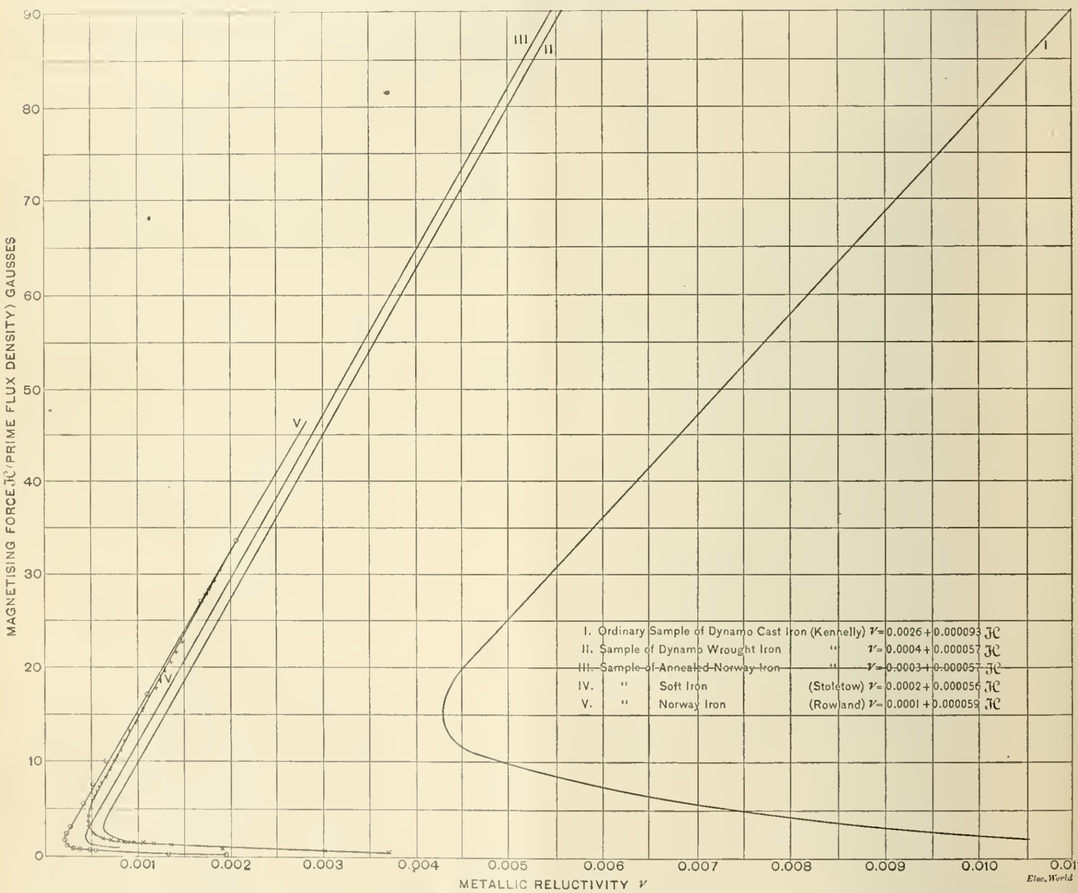


Fig. 46.—Curves of Reluctivity.

Beyond the critical magnetizing force, therefore, the value of the metallic reluctivity may be readily obtained by the equation $\nu = a + b\ \mathcal{H}$, where a, is the reluctivity which would exist at zero magnetizing force, if the linear relation held true below the critical value, and b, is the increase in reluctivity per gauss of magnetizing force expressed by $\mathcal{H}$. According to the fundamental C. G. S.

system reluctivity is a numeric, and its value can never exceed unity. Thus for wrought iron a, = 0.0004, and b = 0.000057.

53. If the ring shown in Fig. 44 be composed of wood and excited by 1,000 ampere turns = 1,257 gilberts, then, since its mean length of circuit (circumference) is 60 cms, and cross sectional area 10 sq. ms, its reluctance will be 6 oersteds, the flux $\frac{1,257}{6} = 209.5$ bweres, and the intensity $\frac{209.5}{10} = 20.95$ gausses, so that the magnetic force has a rate of descent of magnetic potential, the uniform distribution of which is $\frac{1,257}{60} = 20.95$ gilberts per centimetre = 20.95 gausses. Strictly speaking the intensity of the magnetic flux is not uniform over all portions of the area of cross section of the core, being denser at the inner circumference and weaker at the outer circumference. For example, if the inner circumference, instead of being 60 cms., which is the mean, be 58 cms, the gradient of magnetic potential will be uniformly $\frac{1,257}{58} = 21.67$ gausses; while if the outer circumference be 62 cms, the intensity of that circumference will be $\frac{1,257}{62} = 20.27$ gausses. Since, however, all such existing differences of intensity can be made negligibly small, by sufficiently increasing the ratio of the size of the ring to its cross section, we may, for practical purposes, omit them from consideration.

54. Suppose now the core of the ring be composed of soft, Norway iron instead of wood; then from the curves, or the equation,

$$\nu = 0.0004 + 0.000057\ \mathfrak{H},$$

we find that at this mean intensity of $H = 20.95$

$$\nu = 0.0004 + 0.001194 = 0.001594,$$

or about 1-600th of that of air. The mean length of the circuit being 60 cms., and its area, as before mentioned, 10 sq. cms, its reluctance under these circumstances will be $\frac{60}{10} \times 0.001594 = 0.009,564$, oersted, and the flux in the circuit $\frac{1,257}{0.009564} = 131,430$ webers, with an intensity of $\frac{131,430}{10} \div 13,143$ gausses.

If the core of the ring instead of being of soft Norway iron be made of cast iron, the reluctivity, at 20.95, would be approximately 0.0046, and the reluctance of the circuit 0.0276 oersted, making the total flux 45,540 webers, with an intensity of 4,554 gausses, or about three times less than with soft, Norway iron. The practical advantages, therefore, of constructing cores of soft, Norway iron, rather than of cast iron, when a high intensity is required is manifest.

(To be continued.)

Action of a Transformer with a Condenser in Parallel with the Secondary—IV*.

BY F. BEDELL AND A. C. CREHORE.

EFFECTS OF THE VARIATION OF SECONDARY LOAD WHEN THE PRIMARY CURRENT IS CONSTANT.

By means of Fig. 7, which has been explained, we may construct the constant current diagram for a variation in the line resistance R. This diagram is represented in Fig. 12, where OB is the constant electromotive force impressed upon the transformer secondary. Construct the triangle BO′, Fig. 12, similar to B′OC, Fig. 7.

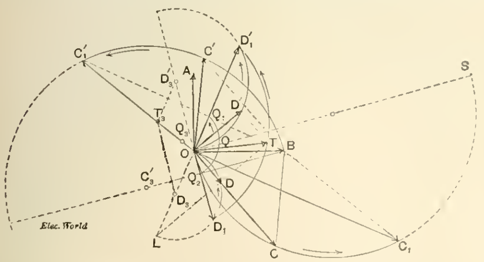


FIG. 12.—CONSTANT PRIMARY CURRENT DIAGRAM SHOWING EFFECTS OF VARYING THE LINE RESISTANCE.

the line OC₁ then represents the position of the condenser E. M. F. upon open circuit. The diameter of the circle upon which OC varies is found by drawing a line OS so that the angle BOS, Fig. 12, is equal to the angle COP, Fig. 7, between the fixed line OC and the perpendicular OP upon the line BB′. The magnitude of the diameter may be found by drawing from C_1 a perpendicular to OC_1 and producing until it meets OS. The locus of OC, the condenser E. M. F., is then represented by the arc OCC_1. The locus of the E. M. F. for the transformer impedance is now determined because the sum of OC and OC′ gives OB. Hence OC′ lies upon a circle $C_1'C'B$ symmetrically situated with respect to OB to the circle OCC_1.

The condenser current is now determined; for it is represented in Fig. 7 by the constant line OD′, a right angle in advance of OC, and equal to $C\omega$ times OC. In Fig. 12 this is represented by the arc $OD'D_1'$, the diameter of which is a right angle in advance of OS and equal to $C\omega$ times OS.

The locus of OQ, the E. M. F. for the transformer resistance, is found by drawing a circle with center Q_3, a point which lags behind C_3 by the constant angle arc tan $\frac{L_2\omega}{r}$. This gives for the locus of QO, the arc Q_1QQ_2. From this the transformer current OT is determined; for it is always a constant multiple of OQ, $OQ = r OT$. One point on the locus is known to be D_1', for here the condenser current is zero. Another point is known to be D_1; for here the condenser here is zero. The centre of the circle T_3 lies upon OQ_3 produced so that $OQ_3 = r OT_3$.

The locus of the line current is upon the arc ODD_1L, the diameter of which OL is a right angle behind OC, or two right angles behind OD_1'. This will appear from the consideration that OT is the geometrical sum of OD and OD′, or that OT_3, is the sum of OD_3' and OD_3 the lines drawn from O to the centers of the respective circles. The heavy part of the circles indicates the range within which a variation may take place and the arrow shows the direction of such varia ion with an increase of line resistance.

ACTUAL DIAGRAM FOR CONSTANT CONDENSER POTENTIAL WHEN THE LINE RESISTANCE IS VARIED.

Fig. 7 represents the case where the line resistance is varied and the condenser potential constant; but it is the typical case and the lines are not drawn to scale. The self induction, too, is not very large compared with the transformer resistance. On the other hand

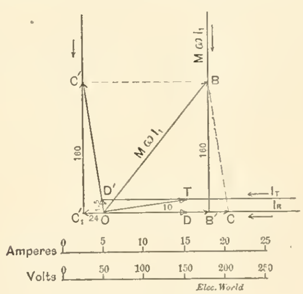


FIG. 13.—ACTUAL CONSTANT CONDENSER POTENTIAL DIAGRAM WHEN $\frac{L_2\,\omega}{r}$ IS VERY LARGE.

Fig. 13 represents the diagram drawn to scale for the particular case of the transformer, the data of which has already been given. The condenser and line potential is arbitrarily chosen as 150 volts, and the capacity of the condenser in parallel with the transformer is 10 microfarads. The particular value of the line resistance represented is 15 ohms, a rather high value. This makes the constant condenser current OD_1 equal to 1.5 amperes, and the line current 10 amperes, for this particular resistance. The transformer current OT will then be only a little more than 10 amperes. The E. M. F. OC′ for the transformer impedance is equal to $L_2\omega$ times OD′, upon open line circuit. This gives OC′ equal to 24 volts. Hence OB′ is 150—24, or 126 volts. The inductance, $L_2\omega$, being equal to .016 × 1000 or 16, is large compared with the internal resistance .16 ohms, and therefore the angle C′OQ of Fig. 7, the typical diagram, becomes here a right angle, C OT. Thus the locus of the impressed E. M. F. OB becomes a line perpendicular to OC.

This diagram may now be easily transformed into the constant current diagram.

*The preceding sections of this article, which is here concluded, appeared in the issues of August 11, September 8 and 29, 1894.

ACTUAL CONSTANT CURRENT DIAGRAM WHEN THE LINE RESISTANCE IS VARIED.

Fig. 14 is the constant current diagram for the case under consideration. It may be derived directly either from Fig. 13 or from Fig. 12. If we take it from Fig. 12 it is simply necessary to make the angle $C_1'OQ_1$ a right angle and all other angles which immediately result from it. Thus the angle BOS of Fig. 12 vanishes in Fig. 14 so that OB coincides with the axis of the semi-circle OCC_1. The diameters of the current circles OL and OD'_1 become perpendicular

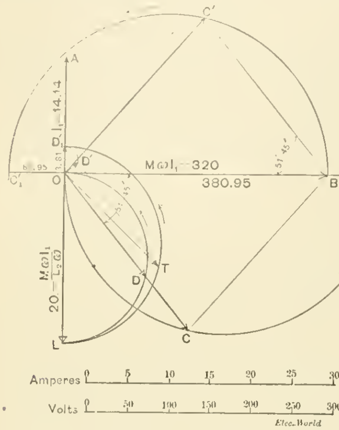


FIG. 14.—ACTUAL CONSTANT CURRENT DIAGRAM WHEN THE LINE RESISTANCE IS VARIED, AND $\frac{L_2\,\omega}{r}$ IS LARGE.

to the impressed E. M. F. OB; for (Fig. 12) the radius OD'_3 is always at right angles with OS, but in Fig. 14 OS coincides with OB. So also OL is always at right angles to OC_1, but in Fig. 14, OC_1 and OB coincide in direction. The resultant or transformer current circle has its diameter coincident with and equal to the sum of OL and OD_1'.

To consider the figure more in detail the primary current of 14.14 amperes maximum value, OA, causes an impresssed E. M. F. OB upon the transformer secondary which is equal to $M\omega\, I_1$, or to $\sqrt{L_1\,L_2}\,\omega\, I_1$; and numerically gives $\sqrt{.032 \times .016} \times 1000 \times 14.14$ or approximately 320 volts.

Upon open line circuit we have a single series circuit through tranformer and condenser, the impedance of which is

$$\sqrt{r^2 + \left(\frac{1}{C\,\omega} - L_2\omega\right)^2}.$$

Numerically this is—

$$\sqrt{.16^2 + \left(\frac{1}{10^{-5} \times 10^3} - .016 \times 1000\right)^2},$$

or approximately 84. Therefore the condenser current which flows upon open circuit is equal to the impressed E. M. F. 320 divided by the impedance 84, that is 3.8095 amperes. This is the value of the diameter OD'_1 of the condenser current locus. The electromotive force OB or 320 volts is the algebraic sum of two components, one OC_1 to drive this current through the condenser and the other for the transformer impedance. The condenser E. M F. OC_1 is equal to the current OD'_1 divided by $C\omega$, that is, is equal to $\frac{3.8095}{10^{-5} \times 10^3} = 380.95.$ So also the transformer part is equal to $L_2\omega$ times this current or $.016 \times 1000 \times 3.8095 = 60.95$ volts. The difference between these E. M. F's viz: 380.95—60.95=320 the impressed E. M. F. Upon short circuit the condenser terminals are joined by a wire of zero resistance and there is then no potential difference at the condenser terminals, and consequently no condenser current. All that we have then is a simple circuit, of impedance

$$\sqrt{r^2 + L_2^2\,\omega^2} \text{ or } \sqrt{(.16)^2 + 16^2} = 16 \text{ approx.},$$

and imuressed E. M. F. 320 volts. This makes transformer and line current equal to $\frac{320}{16}$=20 amperes. This value of the line current upon short circuit is the same as without a condenser. The circle ODL representing the line current locus is the same as if the condenser were not present at all. But this difference is to be noted, *that while the locus is the same it does not follow that for any given line resistance the line current will be the same in the two cases either in direction or in magnitude.* This may be best illustrated by a numerical example. We will suppose that the line resistance is 15 ohms, and that we first have no condenser present, and then secondly connect in the condenser.

In the first case, with no condenser, we have OD lagging behind OB by an angle

$$\text{arc tan } \frac{L_2\omega}{r + R} \text{ or arc tan } \frac{16}{15.16} = \text{arc tan } 1.056.$$

The angle of lag is then 46°30'. The current is then equal to 320 cos 46° 30' /15.16 or to 14.5 amperes.

In the second case, when the condenser is present, we may perhaps most easily find the angle of lag by reference to Fig. 13 from which Fig. 14 is derived. The angle BOC is the same in either figure. It may be obtained as follows from Fig. 13. The tangent of BOC is equal to BB' divided by OB' and OB' is equal to $OC - OC_1' = 150 - 24 = 126$. But $BB' = C'C'_1$. We have the proportion from the similar triangles $OC'C'_1$ and ODT that $\frac{O\,D}{T\,D} = \frac{C'_1\,C'}{OC'_1}$. Hence we have

$$C'_1\,C' = \frac{OD \times OC'_1}{TD} = \frac{10 \times 24}{1.5} = 160 \text{ volts.}$$

This makes BOC = arc tan $\frac{160}{126}$ = arc tan 1.27; and $\theta = 51°\ 45'$ which is a larger angle of lag than when the condenser was absent.

Referring again to Fig. 14, we may find the magnitude of the current by taking the value of OL sin 51° 45' or 20 sin 51° 45' which is 15.7 amperes approximately.

The example shows that shunting the condenser around the secondary actually increases the line current which existed before, and of course also the effective E. M. F. at the line and condenser terminals, but at the expense of increasing the phase difference between the current and impressed E. M. F.

Up to this time no mention has been made of the reaction of the secondary current upon the primary electromotive force and current. It is thought that a single typical example illustrating the case just considered, where the secondary self induction is large as compared with the internal resistance, will suffice.

CONSTANT CURRENT DIAGRAM SHOWING SECONDARY REACTION UPON THE PRIMARY AS THE LINE RESISTANCE IS VARIED.

Fig. 15 illustrates the complete constant current diagram for a variation of the line resistance showing the back and primary E. M. F.'s.

The secondary currents and E. M. F's. have been expiained. The back E. M. F. OF lies upon a circle MF so that OF is always

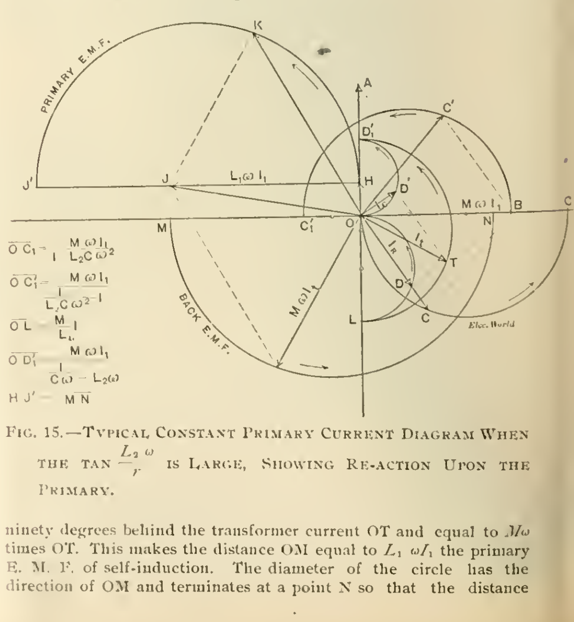


FIG. 15.—TYPICAL CONSTANT PRIMARY CURRENT DIAGRAM WHEN THE TAN $\frac{L_2\,\omega}{r}$ IS LARGE, SHOWING RE-ACTION UPON THE PRIMARY.

ninety degrees behind the transformer current OT and equal to $M\omega$ times OT. This makes the distance OM equal to $L_1\ \omega I_1$ the primary E. M. F. of self-induction. The diameter of the circle has the direction of OM and terminates at a point N so that the distance

ON = $M\omega$ times OD$_1'$. The primary E. M. F. OK has its locus similar to the back E. M. F. circle with diameter HJ equal to MN. Thus it appears that upon open circuit the primary E. M. F. must be considerably larger than it is when the condenser is absent. It is this extra primary E. M. F. which is used for driving the secondary condenser current upon open line circuit.

Below this typical diagram, Fig. 15, there are to be found the expressions for the principal lines and angles which are easily derived from the figures from which this one is constructed.

The more common case where the primary is supplied with a constant potential still remains to be considered. Such diagrams may be constructed directly from the constant current diagrams just discussed. It is considered unnecessary to draw them here, inasmuch as the methods for constructing constant potential from constant current diagrams has been fully given in previous papers. Furthermore, it is not necessary to actually construct a constant potential diagram to properly understand the problem, for, after a little experience with these diagrams one may see the effects certain changes would produce in them without stopping to go through the details of the construction.

The Franklin Institute John Scott Medal.

The Franklin Institute has awarded the John Scott Legacy premium and medal to Clement Payen, the inventor of the chloride storage battery, on the report of its Committee on Science and Arts. The report states that the sub-committee appointed to conduct the investigation had the battery under careful consideration for a number of months, and investigated the several features which are claimed to give it merit. During the larger portion of the time a number of cells were in possession of the committee, and were placed upon a regular working circuit under the control of one of the committee's members, where they were subjected to exactly the same usage as a number of other storage cells of other makers and of the same size, so that opportunity was thus given to obtain the results of the performance of the chloride storage battery in regular use, which is ultimately the final test by which the utility of all inventions and improvements must be measured. The results of this examination led to the opinion that this battery embodies certain features of construction which, the committee finds, prove it, both theoretically and as verified by use, to be a distinct improvement over hitherto known forms of storage batteries.

After recapitulating the principles of storage batteries in general and comparing the features of different ones, the committee reports that their investigations confirm the correctness of the claim that the construction of the chloride plate is such that disintegration is far less liable to occur than in the usual form. In conclusion the report states that, believing that this battery is a noteworthy and meritorious improvement upon many other forms of lead battery, tending to greater durability, greater capacity without increase of weight, and making possible heavier discharges without injury, the Institute, therefore, recommends the award of the John Scott Legacy Premium and Medal to Clement Payen, the inventor.

Fly Wheel Accidents in Power-Houses.

To the Editor of The Electrical World:

Sir:—The increasing number of fly wheel accidents in electric power-houses, particularly those supplying power to railways, has led me to believe that the following may be the cause of many such accidents which have not been otherwise explained.

There are two conditions found in stations: First, where a single dynamo supplies one or more circuits; second, where a number of dynamos running in parallel supply one or more circuits. In the first case, suppose a short circuit on the line to occur, in which case the machine circuit breaker immediately breaks circuit and all the load is removed from the engine. If the short circuit has been caused by the contact of a broken trolley wire with a rail, or any similar cause, it still exists, so far as the line is concerned, after the machine circuit has been broken. Nothing is known, however, in the power-house of the conditions of the line, and the circuit breaker is immediately closed by the attendant. The effect of this is to throw on the engine an instantaneous load much greater than the maximum for which the engine was designed, the load being due to the number of amperes at the machine voltage which would pass over the short circuit. The circuit would, of course, be immediately broken, but not before the engine had received the full impact due to the instantaneous load.

In the second case, suppose one of the dynamos to be overloaded, due to maintaining too large a voltage or for any other reason; the circuit is thereby broken and the engine unloaded, its speed being thereby accelerated somewhat even with the best of governors, and the voltage therefore raised still more. If now the circuit breaker is closed, the machine will be subjected to a still greater load than that which caused the circuit to be broken before. Thus again the engine would be subjected to an instantaneous load greater than that for which it was designed. The preceding are said to be the conditions which existed at a recent power-house accident not far from New York, and the result was the wrecking of the engine and destruction of part of the power-house.

Thus in either case, by the closing of the circuit breaker the engine may have thrown on it with the suddenness of the blow of a hammer, a load of much greater than the maximum for which it was designed. It appears to me that under such conditions the destruction of the engine would be inevitable, and I write to ask the opinion of engineers on this important subject.

Kingston, N. Y. T. C. COYKENDALL.

Distribution with Equalization of P. D.

To the Editor of The Electrical World:

Sir:—I shall be very glad indeed if you will permit me to submit through your columns a few remarks which I think are needful to remove an erroneous impression that seems to have obtained regarding the aim and purport of the paper which I had the privilege of reading at the Electrical Convention in Montreal last week, and to which casual reference was made in your issue dated September 29.

What I endeavored to call attention to is the fact that we can so dispose the quantity of copper that is required for a single circuit two-wire system, in such a way that the potential difference between the mains will be the same at all points of the system; and this without increasing the drop or total amount of energy consumed in the distribution.

In applying the same principle to the three-wire system, I endeavored to show that an increase in the total quantity of copper would be called for, but the economy of adopting the plan even at that cost would be a more than adequate offset.

Now there is an important distinction between this purpose and that which your reference to the matter represents was had in view. The saving that these plans would effect has, where a given current is considered, no direct reference to the volume (that is, the *quantity*) of material composing the circuits; it is incidentally referable to the manner of utilizing the material, as, instead of handling a given number of groups of consumers in separate circuits with a view to some degree of uniformity in the supply, we can take them *en masse* and have thus only to calculate for the maximum percentage of demand on the mains. This is surely a very important consideration and ought no longer to be overlooked.

The expedient suggested in your note of reference as to putting a wire across from the terminals of the sources of current was adopted by a prior inventor of the method, as I took occasion to point out; and if looked at carefully, it will be seen that with such a cross wire, the virtue of the whole scheme is nullified, as then the lamps nearest the sources will get more current than those farthest away—the very thing that it is sought to obviate.

Ottawa, Cnt. D. H. KEELEY.

Electric Whirls.

To the Editor of The Electrical World:

Sir:—Referring to a notice in The Digest of The Electrical World dated September 29, reprinted from a French Academy paper by M. Zenger, I would like to state something about similar experiments, conducted some years ago by myself, and which might prove interesting for some readers of your esteemed paper.

These experiments were conducted with the view of ascertaining the purifying effects of an electrical discharge on air and different vapors. The apparatus consisted of a big, well-corked glass bottle, inside of which two brass combs were fastened exactly opposite to each other. The distance between these combs could be varied. If the current from an influence machine was discharged through the combs, the vapors enclosed in the bottle would at once start whirling around vehemently. The most beautiful effects I obtained in operating with tobacco smoke. The whirls showed exactly the same shape as Mr. Zenger describes, the spires enlarging toward the middle. After a short time, the smoke would disappear entirely, leaving only a precipitate of nicotine on the walls and of ashes on the bottom of the bottle. R. T. ESCHER.

New York, N. Y.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Currents in Open Circuits, Dielectrics and Electrolytes.—An Academy paper by Mr. Nicolaieff on two methods for studying currents in open circuits and the currents of displacement in dielectrics and electrolytes, is given in abstract in "L'Elec.," Sept. 15. He concludes, among other things, that electrolytes act like perfect dielectrics and that they therefore do not conduct like metals; a note at the end states that the results are deduced from too few experiments to enable them to be accepted as indisputable.

Alternating Currents in a Divided Circuit.—In an article by Mr. Russel in the Lond. "Elec.," Sept. 21, he discusses the problem of finding the alternating currents in a divided circuit when the mutual induction is appreciable; he discusses it graphically and algebraically, showing that the former is the best way of solving the problems.

Action of Alternating Currents on Dielectrics.—The Lond. "Elec. Rev.," Sept. 21, replies editorially to the note of Mr. Addenbrooke abstracted in the Digest last week, but gives nothing new.

Fluorescence a Phenomenon of Ionic Origin.—Recent investigations made by Mr. Buckingham appear to support the belief that the phenomenon known as fluorescence is of ionic origin; a large number of observations were made and in every case the observed results were as expected. The paper is published in the "Zeit. feur Phys. Chem.," vol. 14, p. 109, and is very briefly abstracted in the Lond. "Elec. Rev.," Sept. 21.

Migration of Ions.—The Lond. "Elec. Rev.," Sept. 21, abstracts briefly and recommends a paper by Mr. Bredig in the "Zeit. feur Phys. Chem.," vol. 13, p. 191.

MAGNETISM.

Magnetic Lag.—A paper by Mr. Dechant on the magnetic lag in iron cores due to periodic alternating magnetizing forces, is published in the "Zeit. feur Elek.," Sept. 15; he discusses it analytically and graphically, giving a simple graphical solution. He shows that two periodical alternating magnetizing forces of a certain phase difference, when acting on different parts of an iron bar, develop magnetic waves of varying amplitude, which travel along the iron but with relatively small velocity; the latter is found when the distance between the places where the forces act are divided by the phase difference; he proves this experimentally. He also shows that the diminution in the intensity of the magnetization along the bar is an essential condition for the existence of this lag. (Another paper on this subject, by the same author, was abstracted in the Digest, July 28.)

Magnetic Constants of Soft Iron.—A paper by Dr. Froelich is published in the "Elek. Zeit," Sept. 20; it is supplementary to his other recent paper (see Digest, Aug. 4), in which he endeavors to establish the law of the magnetization of iron; he deduces the constants occurring in his law, from a number of different observed results with different irons, and shows how the calculated and the observed values agree; he shows that good magnetic experimental data can always be represented by a formula with close agreement; the various coefficients determined for a number of different irons differ very considerably from each other, and those obtained from one set can therefore not be applied to another. He discusses the various methods for making measurements and concludes that there is no doubt that the best method for obtaining the magnetization curve is by means of a closed ring of iron. The present paper also answers the recent criticism of Mr. Culmann (see Digest, Sept. 1).

Tubular Magnets.—Mr. Boult, in the Lond. "Elec. Rev.," Sept. 21, states that in designing a special apparatus in which a permanent magnet was to be alternately operative and inactive, he decided upon a straight tubular magnet with a movable iron core; as the side pull is balanced, friction is reduced to a minimum and the end pull is very slight; by moving this core in and out the pull of the magnet becomes inactive or active respectively. He asks for an explanation for the way in which the return lines of force in this apparatus are able to cut through the steel without destroying its magnetism; he offers the explanation that they cut in or out of the tube gradually throughout the time occupied in the movement of the core; the amount of demagnetizing force at any instant is therefore small as compared with the permanent magnetization.

Magnetic Researches.—A paper by by Mr. Fromme from the "Wied. Ann.," vol. 53, page 236, on the self-induction and electrostatic capacity of coils and their influence on magnetic phenomena, is abstracted in the "Elek. Zeit.," Sept. 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Construction of Resistances.—An Institution paper by Mr. Morris (read in March) is reprinted in the Lond. "Elec.," Sept. 21. He divides resistances into those which have a fixed value, for carrying inappreciably small currents, and those for absorbing power; for the former there are only four alloys, platinum silver, German silver, platinoid and manganin. A table is given containing the composition, the specific resistance and the temperature coefficient for these, as also for other materials used, including iron, carbon, sulphuric acid and sulphate of zinc; a diagram is given showing the specific resistance as a function of the temperature for each of these materials from zero to 200 degrees, based largely on the researches of Dewar and Fleming. He gives the following general rule, that roughly the specific resistance (in ohms per cubic centimeter) divided by 1,000 is equal to the resistance in ohms of a mile of No. 17 B. W. G. wire of that material, or it is the resistance in ohms of 100 yards of No. 28 wire. Manganese steel, containing 12 per cent. of manganese, has by far the largest specific resistance of any substance available in the form of wires, excepting "Kruppin" (see Digest, Jan. 6 and Feb. 3), whose specific resistance is 83,000, the temperature coefficient being about the same; manganin, which is used largely on the Continent, has little or no temperature coefficient; it contains about 84 per cent. of copper, 12 per cent. of manganese and 4 per cent. of nickel; it seems to have a maximum resistance almost exactly at ordinary temperatures, but slight variations in its position seem to shift this point considerably. Iron wire doubles its resistance by the time it gets fairly hot, while with carbon, in the form of incandescent lamps, the resistance while hot is about one-half that when cold; the temperature coefficient of the liquids used is much greater, being for a saturated solution of sulphate of zinc equal to a diminution of 2.3 per cent. for a rise of one degree C. He discusses standards and shows how they are constructed, describing the modified form of Dr. Fleming, in which the coil is contained in a shallow metallic ring of brass, so as to take the surrounding temperature rapidly and also to rapidly get rid of the heat generated by the current. German silver, he states, becomes rotten in the course of time, owing to the crystallization of the zinc; manganin is unfortunately liable to change owing to the oxidation of the manganese, leaving, as the only practical alloy, one made of one part of platinum and two parts of silver.

Copper and German Silver Coils in d'Arsonval Galvanometers.—In an article by Mr. Meylan in "L'Elec.," Sept. 15, he discusses, in a practical manner, the relative merits of galvanometers of the d'Arsonval type, in which a coil moves in an intense magnetic field, first when the coil is made of copper and then when it is made of German silver. He considers the case of a wide range instrument in which the galvanometer is shunted and at the same time in series with a resistance, the variations of both of which give it a wide range; unless the coil and the shunt are made of the same metal the temperature coefficients will introduce errors, which may, with a German silver shunt and copper coil, become 3.6 per cent. for 10 degrees difference of temperature; such shunts should therefore be made of the same metal. He gives the various constants for an assumed range, first when the coils are copper and then when they are German silver, and concludes that the latter method, which is more general and more precise, requires more attention on the part of the operator and can therefore not be put into every one's hands; having lately had occasion to equip a complete laboratory he concluded to adopt the first method for the ordinary measurements which can be made by any one, while he reserved the second method for an apparatus of precision for standardizing.

Hot Wire Instruments.—A recent form made by Hartmann & Braun for amperes and for volts, is illustrated in the "Elek. Zeit.," Sept. 20; the deflection of the middle of a short stretched wire is used to deflect the needle; it is made aperiodic by magnetic damping, a small disk of aluminum being moved between the poles of a powerful permanent magnet.

Recording Instruments.—A new form made by Messrs. Nalder & Harrison is illustrated and described in the Lond. "Elec. Eng.," Sept. 21; the instrument is made on the d'Arsonval type, and it is claimed that it records variations of less than 0.3 per cent.; the record is made on the usual revolving drum; they are made for amperes or volts.

Phase Meter.—A translation of the article abstracted in the Digest, July 21, describing the instrument of Mr. Dobrowolsky, is published in the Lond. "Elec.," Sept. 21.

Symbols and Abbreviations.—The Lond. "Elec. Rev.," Sept. 21, reprints the table published in The Electrical World, Aug. 25, together with modifications suggested by Prof. Jamiesen; these are briefly as follows: For angles the Greek letter α is too much like the letter a; he prefers β and θ; he recommends the use of H. P. for horse-power, I. H. P., B. H. P., and E. H. P. for indicated, brake and electrical horse-power respectively; he thinks K is not suitable for moment of inertia and claims that there is no need of any single letter as it is sufficiently well expressed by the product ML^2; K should be reserved for "kapacity," which he suggests spelling with a k when used in a truly electrical sense to distinguish it from capacity as used in many other senses, like the capacity of a dynamo; instead of the French script letters for the magnetic units, which he says are difficult to write on paper and the blackboard and are not usually in printer's fonts, he greatly prefers the Clarendon or block or boldfaced type; for reluctivity he prefers writing the reciprocal of permeability, as the Greek letter, ν, is easily confounded with v; he objects to the use of U and u, recommending v for volts or P. D. for potential difference, instead; he strongly objects to the use of I and i for current, recommending C and c; for the earth's field he suggests the italic H as distinguished from the boldfaced type for local fields; for electric power as distinguished from mechanical power, he prefers W_p or P_w, the former meaning watt-power and the latter power in watts, which he says is the true and only meaning; he thinks there is no use of the letters G and g for reluctance, since the reciprocal of K is quite sufficient; the letter G should be reserved for gauss, when this term is adopted; for self-induction he suggests L_s and for mutual induction L_m; in place of the word "per" he suggests the sign / in preference to a colon; a small capital A should be used for ampere since small capital V is used for volt, and he suggests using the accepted ω for ohm and Ω for megohm; instead of mho he would simply use the reciprocal of ohm; he thinks that the terms gauss, weber, gilbert and oersted are neither well chosen nor necessary and "if the necessity should arise" for words to express the quantities they should be very carefully discussed together with others "which are more suggestive of the expressions which they are to indicate;" he suggests the use of Greek letters for the dyne and the erg.

Alternating Current Relay.—A relay invented by Dr. Aron is described and illustrated in the "Elek. Anz.," Sept. 10; it is intended to overcome the difficulties encountered in such relays and consists briefly of a solid copper secondary coil of a small tranformer, the coil being pivoted so as to move and thereby opened and closed a contact; the coil is also situated between the poles of another electro-magnet, around which the main current passes; the first coil induces a current in the copper ring which, being under the influence of the other magnet, produces a deflecting torque.

Photometry.—In an article on "A New Photometry" in the "Elek. Tech.," Sept. 15, a paper of Mr. Crova is abstracted (although not so stated, this paper is believed to be the one read at the Congress of 1889 in Paris).

Definition.—A definition of electro-motive force by Mr. John Sprague is given in the correspondence column of the Lond. "Elec. Eng." Sept. 21.

ARC AND INCANDESCENT LIGHTS.

Arc Lamp with Two Arcs.—The Money-Nash lamp is described and illustrated in the Lond. "Elec. Rev.," Sept. 21; there are two arcs in series, controlled by one set of mechanism and it is intended to replace the usual wasteful resistance for reducing the voltage to 45 when only one pair of carbons is used (presumably from an incandescent light circuit of 100 volts); both arcs burn at the same time and it is claimed that with six amperes the light is equal to an ordinary lamp taking ten amperes, representing a saving of 6½ cents per hour to a consumer using single lamps from a 100-volt circuit, at the rate of 16 cents per kilowatt-hour, or twice the amount of light at no extra charge for current; they are adapted to both alternating and continuous currents; they state there was a variation of two volts while feeding, which the editors think is too much.

Alternating Arc.—Mr. Brown, in a communication to the Lond. "Elec.," Sept. 21, states that he found experimentally that the band of violet light of the usual alternating arc lamp could be gotten rid of and the efficiency increased by using a solid carbon for the top and a cored carbon for the bottom, in place of two-cored carbons as usually employed; the arc is then shortened to its normal length and is claimed to have an increased temperature with a whiter light. In an editorial the belief is expressed that this is not a complete cure.

Lighting of Workshops.—A note in the "Zeit. feur Elek.," Sept. 15, calls attention to the advantages of the inverted arc lamp; a 10-ampere 45.5-volt lamp gives a maximum of 2,070, and a mean spherical of 750-cp of which 640 are below the horizontal plane through the arc; by means of the inverted arc and a reflector almost the whole of this spherical intensity can be produced below the lamp and it will be then equal to about 46 incandescent lamps of 16-cp, which at 50 watts require 2,300, while the arc lamp requires only 455, representing a saving of about 400 per cent.

Differential Arc Lamp.—A new form is illustrated and described in the "Elek. Anz.," Sept. 16.

Reducing the Candle-power of Incandescent Lamps.—In a communication to the Lond. "Elec.," Sept. 21, Mr. Sharp gives some further information about the system which was recently ridiculed in the English journals. The method which he now describes is one in which a cluster of lamps is coupled by means of a switch into groups in which the lamps are connected in series and multiple in different ways; in case one 16-cp lamp is required he uses two lamps of 8-cp, connecting them in parallel for 16-cp and in series for a lower candle power; by this means he claims to obtain a "plesant mellow light" with a great saving of current.

Mercury Poisoning.—The "Elek. Anz.," Sept. 20, mentions a recent paper by Dr. Donath, calling attention to the mercury poisoning in incandescent lamp factories, to avoid which he recommends large rooms, the introduction of ventilators, cleanliness of the workmen, the use of the Sprengel pump in preference to the Toepler, as it requires only one-tenth of the amount of mercury and is less easily broken; mechanical air pumps are of course still better; the use of mercury pumps driven by air pressure is also recommended as they are much less likely to break.

Candle-power of Incandescent Lamps.—Another article from Dr. Fleming's forthcoming book is published in the Lond. "Elec.," Sept. 21; it contains nothing new. He gives curves for the variation of the candle power, for the current, the voltage, the watts and the watts per candle; the candle power varies approximately as the fifth or sixth power of the current; it varies also very nearly as the cube of the total power in watts.

Incandescent Lamp Tests.—The results of some tests giving the candle-power and current at a constant voltage for a series of 500 hours for five different lamps are published in the "Elek. Zeit.," Sept. 20; the lamps were made by a German firm.

General Theory of the Incandescent Lamp.—A paper by Mr. Weber read at the Frankfort Congress (1891?) is reprinted from the "Physical Review" in the Lond. "Elec. Eng.," Sept. 21.

ELECTRIC RAILWAYS.

Liverpool Overhead Railway.—The discussion of the papers of Messrs. Greathead, Fox and Parker (see Digest last week) is concluded in the Lond. "Elec.," Sept. 21; the present portion is devoted almost entirely to the electrical features, and contains much that is of interest; the following are a few extracts from it. Mr. Cottrell, in referring to the commutators, states that they now run 9,500 miles and one of them 16,000 miles without "skimming" (presumably meaning "turning down"); the carbon brushes at first cost about $30 per week, but have now been reduced to $10.20, and it is hoped shortly to get it to $5 per week; flat carbon brushes are used; round carbons, as also copper gauze, have been tried, but without success. The railway stations are lighted by two sets of lamps, one in series from the main conductor and the other in parallel from the accumulators; the automatic signals have answered admirably and effected a very considerable saving in the working expenses; with coal at $2.06 per ton the haulage was 6.96 cents per train mile and at $1.50 per ton it would be only 6.68, including all wages, stores, etc. Mr. Alexander Siemens referred to the subject of motors on the cars as distinguished from separate locomotives, and said that the choice had to be decided in each case on its particular merits, as it was not possible to say that either one was universally the best; on the Liverpool line there were only two cars to a train and the arrangements for working the motors from one end or the other were comparatively simple, but on a railway with more cars the question of the switching arrangement was very serious; the multiplication of small motors on the cars also meant a serious increase in their cost; comparisons are made with the City and South London road and the Liverpool road; in the former he shows that one locomotive ran about 40,000 miles and another 50,000 without requiring any considerable repairs, and he believes that there is no steam locomotive which has such a record; one of them had run with the same pair of brushes since it was delivered. Regarding the loss of energy at starting, he suggests that a very good way was to put a motor generator on the locomotive, using a high pressure current of 2,000 volts, and putting the motors directly on the axles, stating that the extra cost was not very much more than in the present plan, but it introduced complications, and the present arrangement, though wasting more energy, was preferable because it was simpler. The average watts per train mile in the City and South London line were 21,320, while in the Liverpool line, with trains of about the same weight, it was 32,650; the great point in electrical railways was to have frequent service, and he believes it perfectly impossible to introduce electric traction satisfactorily on railways on which there are only three or four trains a day. Mr. Blackwell stated that an underground conductor in a slotted conduit can be used satisfactorily, but was very much more expensive, as it cost approximately $35,000 a mile for a more or less efficient system, while it cost about $3,500 a mile for a first-class practicable overhead conductor system; the reason why the overhead conductor had been adopted in the United States was simply a financial and practical one; he believes that the objections urged against overhead wire were much less important than those of a system involving interference with the street service and the maintenance of an open slot. Mr. Sellon referred to the South Staffordshire railway and the side trolley system adopted there, which dispenses with span or pull-over wires. Mr. McDonnell compared the Liverpool with the Metropolitan steam road in London, stating that the latter is not in any way adapted

the electric system, as in some parts there was a half hour service in which the electric system, he claims, would certainly not be economical, as the latter is adapted to light trains run very frequently. Mr. Beaumont discussed the subject of starting the train, stating that he had shown on a previous occasion that it would be possible, by mechanical means, to avoid taking more power than was necessary for keeping the train in motion; he believes that there is no electrical method known for surmounting that difficulty. Dr. E. Hopkinson took exception to a number of statements; the efficiency between the indicated horse-power in the steam cylinders and the electric horse-power delivered from the terminals of the dynamo, was given as 88 per cent.; this he was not at all prepared to accept; the best results obtained by the Willans engine has never exceeded 87 per cent., using direct driving, while in the present case rope driving was used; he works out that the loss in engine friction, ropes and dynamos, and by electrical friction of various kinds in the armature, was only 10 per cent., if the total efficiency is 88, and such a result was absolutely impossible. He makes some deductions from the figures given and finds that the average tractive force per ton of train was 55 lbs., which he calls extraordinary; in the City and South London line it was 16 lbs. per ton of train of practically the same weight and working under the same conditions; from some deductions he finds that the tractive force in the Liverpool line was 35 lbs. per ton, that is the force required to overcome the resistance only and not to give the train acceleration; this was more than double the same figure for the City and South London line and also greatly in excess of common experience. The total cost of traction on the Liverpool line, including current for signaling and lighting, was 7.95 cents per mile, with coal at $1.10 per ton, while on the City and South London line, including current for lighting, but not signaling, it was 12.44 cents per train mile, with coal at about three times that price and higher rates of wages; the repairs on the lines were 1.9 and 1.4 cents per train mile respectively; many of the locomotives had now run over 100,000 miles, and the cost of repairs during the last 30,000 did not exceed 0.06 cents per train mile. Mr. Parker, in replying, stated that the trains on the Liverpool line required less energy at starting than when in motion, the motors being put in series for starting and afterwards in parallel; in comparisons with the City and South London line the trains of the Liverpool line were 12 per cent. heavier, ran at 24 per cent. greater average speed, and made about 50 per cent. more stops; comparisons were therefore misleading unless these features were considered; he believes that there is no difficulty in running the Metropolitan (London) trains with the same proportionate economy as the trains on the Liverpool line; he believes that the depreciation of the dynamos and motors will be found to be less than with steam engines. On the City and South London line the tractive force for 150 amperes was 50 lbs. per ton of train, while on the Liverpool line it was 120 lbs. for the same current; he believes that Dr. Hopkinson's figures do not apply when the motors are constantly starting and stopping; on the Liverpool line during January and February each train took an average of 36.5 electrical hp, while on the City and South London line it was 33. Mr. Aspinwall claimed that the engine mile was the only figure which could be applied in order to make comparisons upon a proper basis; on this basis one of the largest steam railways in Great Britain was able to run at slightly more than 12 cents per engine mile, including maintenance and renewals of its stock, while the 8 cents for the Liverpool line, did not include renewals of stock; the cost of running the Liverpool line, after making certain reductions, is about equivalent to that of any ordinary light steam railway; there was no first-class railway in England, which consumed more than an average of 41 lbs. of coal per engine mile; he cites a case in which it was 16 lbs.; he believes the Liverpool line could be run with steam locomotives for slightly less than 12 cents per mile, including maintenance and depreciation of locomotives. Mr. Crompton believed that the efficiency of 88 per cent., mentioned above, could not possibly be obtained under the circumstances.

Sectional Contact Rail System at Lyons.—"L'Elec.," Sept. 15, publishes at some length and with the aid of a number of illustrations, the first part of a description of the Claret and Willemier system, which has been running for five months in the city of Lyons. The power is generated by a gas engine using a cheap form of gas made on the premises; the coal consumption is said to be 1.1 lbs. per horse-power hour for a 100 hp engine. The current for the car is taken from strips of iron on the pavement midway between the tracks, about 9 ft. long and about 10 ft. apart from each other; the car touches one before leaving the other; these strips are connected to the underground circuit only while the car is over them; the feeder is located under the sidewalk, and is connected to the various sections through a somewhat complicated apparatus called a distributor, wihch is placed at about every 300 ft. along the line and provides for the connections of 10 to 18 sections; this distributor is described in detail and appears to consist of series of contacts, one connected to each section, the contact maker being operated by the force of a weight suspended on a drum, like in a clock, and actuated by an electromagnetic device; this latter appears to be operated by a current from the previous section, which is led by means of the car through the next section which is to become active; the article is to be continued.

Suspended Railway System.—The Langen system is described and illustrated in the "Elek. Anz.," Sept. 20; the cars are suspended from rails secured to an overhead structure.

Gas Traction.—An editorial in the Lond. "Elec.," Sept. 21, states that gas traction has been adopted on a road at Blackpool in which a syndicate is to run it for seven years at a sum of 9 cents per car mile, with a minimum of 163,000 car miles per annum.

Locomotives.—Referring to the electric locomotives recently made in this country, in which the tractive force of 373 lbs. per ton of locomotive was obtained, the Lond. "Elec.," Sept. 21, states that on the Liverpool Overhead Railway a tractive force of 750 lbs. per ton (of train?) is obtained, and 234 lbs. per ton of steam engines of the London district underground railway.

Heating Cars.—According to the Lond. "Elec.," Sept. 1, the cars on the Saleve electric track railway are heated electrically: the resistances are made of galvanized iron wire 1.5 mm in diameter, and a total length in the two heaters of 500 meters; the two heaters are connected in series, requiring a current of 15 amperes, equivalent to 10 hp; the temperature of the wire reaches 100° C., and even in the severest weather the car is heated to 15° or 20° C. in 10 to 15 minutes.

Dresden.—An electric line near this city with some features differing from those of lines in this country, is described and illustrated in the "Elek. Echo.," Sept. 2.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Regulating the Phase in Alternating Current Circuits.—In a paper by Mr. Imhoff in the "Elek. Zeit.," Sept. 20, he calls attention to a recent statement by Prof. S. P. Thompson (see Electrical World, Sept. 1, p. 208) in which it was shown that a synchronous alternating current motor can, by regulating the excitation of its field, act either as a choking coil or as a condenser, and can therefore be used to regulate the phase and to compensate for phase differences in long lines or in circuits containing motors. As this involves extra machinery, Mr. Imhoff suggests the following simple method, which requires no extra machinery. The continuous current exciter of the alternators, besides having the usual commutator, is provided with two slide ring contacts from which an alternating current may be obtained; when the alternator and exciter are running properly the alternating current circuit of the exciter is connected to the alternating current mains, due care being of course taken to first establish synchronism, the belt or other device for driving the exciter being at the same time thrown off; the exciter will then run as a synchronous motor driven by the current from the mains; any phase differences between the two or more alternators are then adjusted by resistances in the circuit of their respective fields, and any phase differences between the current and the voltage in the mains are adjusted by means of a resistance in the field circuit of the exciter; the alternators can then always be made to run under the most favorable conditions; the great advantages which phase regulators have in the economical running and in the reduction of the cost of an installation, will, he believes, lead to their general adoption.

Advantages of Alternating Currents.—In the Lond. "Elec. Rev.," Sept. 21, Mr. Appleyard contributes to the discussion started by Prof. Thompson's statement, more particularly to the statement made by that Journal, abstracted in the Digest Sept. 15 and 22. He states that reversing the current in cable testing for breaking down faults, is not to be considered as an evidence of the effect of an alternating voltage upon a cable, such an assumption being absurd as it ignores the time element. The statement that the stressing pressure is the maximum value, as distinguished from the mean value, he states, is opposed to experience, and the stress on a cable in an alternating system can never reach a sine curve or sawtooth tops as long as dielectrics absorb the current. In replying to this the editors state that they had reference to the breaking through of a weak spot in the insulation so as to make a puncture; they claim that reversing the battery current repeatedly has always been used for accelerating the breaking down of high resistance faults.

Rectifiers.—In the English journals Mr. Ferranti replies to a recent statement by Mr. Walker in which it was claimed that rectifiers were mere laboratory toys; Mr. Ferranti in a letter published in the Lond. "Elec. Eng.," Sept. 21, states that the arc lighting by means of rectifiers at Portsmouth has proved to be the most complete success; he cites a number of plants for which rectifiers have been ordered and claims that there are now no consulting engineers of any importance who are not ready to furnish rectifiers for street lighting.

Rules and Regulations for Installations.—In the "Elek. Zeit.," Sept. 20, Dr. Gusinde suggests a series of rules and regulations for electrical installations. At the end he gives an interesting set of simple conventional signs for representing the different parts of an installation; an incandescent lamp, for instance, is represented by a cross like a multiplication sign, a figure attached representing the candle-power and the addition of a few diagrammatic lines shows whether the socket is to include a key, whether the lamp is on the horizontal or vertical bracket, etc.

Temesvar.—A description of the installation in this city is published in the "Zeit. feur Elek.," Sept. 15. This is said to be the first city on the Continent of Europe whose streets were lighted throughout with electric light; the installation was opened in 1884.

Statistics.—Some statistics for installation in Austria for 1893 are published in the "Zeit. feur Elek.," Sept. 15.

WIRES, WIRING AND CONDUITS.

Conduits.—A recent gas explosion in France is discussed in the Lond. "Elec.," Sept. 21, and it is stated that as a result of the explosion the following regulations were agreed upon: no work to be done by either the gas or electric companies in the neighborhood of the mains of the

other without due notice; the electric light company is to substitute earthenware castings for those of cast iron for their branch services; and branch gas service pipes in the neighborhood of electric light mains are to be laid in wooden boxes filled with natural bitumen.

Graphical Wiring Table.—The Howard table is briefly described in the Lond. "Elec. Eng.," Sept. 21; a special feature is that a logorithmic scale is used, by means of which diagonal lines are made parallel instead of being radial, thus enabling all parts of the table to be deciphered with equal ease.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephony.—It is said that Madrid and Paris will shortly be connected by a telephone line.

Telephone System in the Arlberg Tunnel.—A description of this system is published in the "Zeit. feur Elek.," Sept. 15.

Pacific Cable.—An article is contained in the Lond. "Elec. Rev.," and "Elec. Eng.," Sept. 21.

Statistics.—Some telegraph and telephone statistics for Austria for the year 1893 are given in the "Zeit. feur Elek.," Sept. 15.

ELECTRO-CHEMISTRY.

Chlorine and Soda.—The Castner process is referred to in the Lond. "Elec. Eng.," Sept. 21; it is said to differ radically from the other processes, its essential feature being the use of a mercury diaphragm (see Digest, Oct. 7, 1893); the process is continuous and it is claimed that the electrical efficiency is 88.9 per cent., also that no hypochlorides are produced, their production being a defect in other kindred processes; an installation at Oldbury has been in regular operation for over six weeks, and it was found that a cell six by three feet and six inches deep decomposes 56.5 lbs. of salt daily, producing 38.5 lbs. of chlorine in 24 hours, with an expenditure of 3.5 indicated hp; the caustic solution produced contains 20 per cent. of caustic soda and yields a solid caustic of 99.5 per cent. purity, while the chlorine is of 95 to 97 per cent. purity; the plant contains 30 cells; it is claimed that a number of experts have expressed a favorable opinion of the process.

Bleach.—The Gebauer-Knoefler process for the electrolytic manufacture of bleach is briefly described in the "Zeit. feur Elek.," Sept. 15.

Chlorate of Potash.—The electrolytic process of Messrs. Hausermann & Naschold for its preparation, is briefly described in the "Elek. Anz.," Sept. 13, taken from the "Chem. Zeit.," p. 857.

Electro-zincing.—The Lond. "Elec. Rev.," Sept. 12, gives briefly some further information regarding the Cowper-Coles process (see Digest, February 24 and March 31) together with some illustrations of the apparatus. Most authorities are said to recommend a current of 18 to 20 amperes per square foot and a solution of zinc sulphate, acetate or chloride; electrolytes made by adding potash or soda to a zinc salt are found to be unworkable on account of the formation of an insoluble zinc oxide on the surface of the anode; deposits from acid solutions are of a transitory nature and the durability is not as great as with hot galvanizing, as the deposit is porous and retains some of the acid salts; the Cowper-Coles process is said to overcome some of these difficulties; but how, is not explained. The articles are first treated in a "potash boil" at 200 degrees F.; they are then placed in a pickling tank made of a weak solution of sulphuric acid and water kept in circulation, then in a washing tank, after which they are placed in the zinc bath; the current density is about 50 amperes per square foot, the total output of the dynamo being 2,500 amperes at 5 volts; a detailed account of a plant now being erected with a bath capacity of 14,000 gallons is promised. In another description, in "L'Elec.," Sept. 15, it is stated that the electrolyte used is like that in the ordinary baths, except that oxide of zinc is added, the presence of which, according to the inventor, aids the electrolytic action and overcomes the difficulties encountered in the other processes.

Chemical Theory of Accumulators.—An article by Mr. Wade is begun in the Lond. "Elec.," Sept. 21. He discusses the history of accumulators and shows that there is practically no difference between a storage and a primary battery; regarding the lead cell he states that the amount of energy that one pound of lead would generate if wholly converted into lead sulphate could be produced by about ¼ lb. of zinc or iron, or about ½ lb. of copper; practically the very property of lead which at present constitutes its superiority to other metals, that is, the insolubility of its sulphate, at the same time limits its efficiency by reducing the energy obtainable to a small fraction of the theoretically possible amount; the active material requires a grid and under the best conditions not more than half the active material is really acted upon, the result being that not more than 5 to 15 per cent. of the total weight of electrodes is usefully employed.

Accumulator Plate.—The "Elek. Anz.," Sept. 9, contains an illustrated description of a plate, the main frame of which is made of some inert material, such as hard copper enclosed in lead.

Velvo Carbon Battery.—The primary battery mentioned in the Digest last week in connection with the launch "Velvoca," is briefly described in the Lond. "Elec. Rev.," Sept. 21. It is a Smee cell with an improved carbon covered with fine filaments of carbon, from which the hydrogen readily escapes; these electrodes consist of Lacombe arc light rods, nine mm in diameter, one foot long with velveteen cemented upon them and afterwards carbonized at a high temperature; when used for a depolarizing solution there are similar rods, but covered with deep-pile corduroy instead of velveteen; they are made for coring, but are uncored, a No. 28 silver wire 2 ins. long being wedged into the core hole by means of a celluloid wire wedge in order to form a good connection when entirely under the surface of dilute sulphuric acid; when the connection is above the liquid a platinum wire is used, protected with ozokerit wax; the silver connection costs ¼ cent, and the platinum connection 4 cents; the spent solution is removed by means of an ebonite pump and the fresh solution is led to the cells through leaden pipes; the cells are filled or emptied in ten minutes and the zincs are replaced in half an hour (but it does not say for what size of battery); the E. M. F. remains fairly steady at 0.5 volt until the soluton falls considerably in strength; no form of Smee battery can have even a moderate efficiency; what is aimed at, however, is not efficiency but simplicity, absence of porous pots, no corrodable connections, no depolarizer, no fumes, etc.; tests by the inventor give an output of 67 watt-hours for a consumption of 5¾ oz. of zinc and 1¼ lbs. of acid, equal to 5 lbs. of zinc and 18 lbs. of acid per kilowatt-hour; the zinc costs 10 cents per pound and the acid one cent, so that at a discharge of 19 amperes the cost is about 70 cents per kilowatt-hour; at a discharge of 60 amperes 6½ lbs. of zinc were consumed per kilowatt-hour, making the cost per kilowatt-hour 80 cents. Prof. Jamieson, in reporting on this cell, states that the carbons are much superior to plain carbons; the silver connections are said to be lighter and cheaper than any other metal known; he obtained a charge of 30 amperes for a seven hour continuous run, with a consumption of zinc of 2¾ lbs. per thousand ampere-hours, and a consumption of sulphuric acid equal to nearly 1½ lbs. per pound of zinc consumed; the cell weighs 17 pounds and gives an output of one watt per pound; weight for weight it yields a greater output than any other primary or secondary battery with which he was acquainted.

Primary Battery.—The Lond. "Elec. Rev.," Sept. 21, discusses very unfavorably the recently published inventions of Mr. Coad, whom it classes as either a knave or a fool.

MISCELLANEOUS.

Treatment in Case of Accident.—A brief set of rules by Dr. Hedley, taken from the "Lancet," is published in the Lond. "Elec. Eng.," Sept. 21, and printed in abstract elsewhere.

Lightning.—A recent case in which a rabbit was killed and had its fur burned off, is discussed in the Lond. "Elec. Eng.," Sept. 1.

Electricity in Agriculture.—Some applications of power in agricultural work are described and illustrated in the "Elek. Echo.," Sept. 15.

Educational.—Another lecture and another section of the examination questions of the City and Guilds Institute, are given in the Lond. "Elec. Eng.," Sept. 21. Some examination questions are also published in London "Electricity," Sept. 14 and 21.

Exhibition of 1900 at Paris.—The Lond. "Elec. Rev.," Sept. 2, publishes some information of interest to intending exhibitors.

Prizes.—A list of the prizes offered by a French Society are published in "L'Elec.," Sept. 15.

Moonlight Tables for November, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of November under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P. M.	2	5.30 A. M.
2	7.20 "	3	5.30 "
3	8.30 "	4	5.30 "
4	9.30 "	5	5.30 "
5	10.30 "	6	5.40 "
6	11.30 "	7	5.40 "
7			
8	12.30 A. M.	8	5.40 A. M.
9	1.40 "	9	5.40 "
10	2.40 "	10	5.40 "
11	3.50 "	11	5.40 "
12	No light.	12	No light.
13	"	13	"
14	5.10 P. M.	14	6.40 P. M.
15	5.10 "	15	7.30 "
16	5.10 "	16	8.40 "
17	5.10 "	17	10.00 "
18	5.10 "	18	11.10 "
19	5.10 "	20	12.20 A. M.
20	5.10 "	21	1.30 "
21	5.10 "	22	2.40 "
22	5.10 "	23	3.50 "
23	5.10 "	24	5.00 "
24	5.10 "	25	6.00 "
25	5 10 "	26	6.00 "
26	5.00 "	27	6.00 "
27	5.00 "	28	6.00 "
28	5.00 "	29	6.00 "
29	5.00 "	30	6.00 "
30	5.00 "	1	6.00 "

Total No. of hours, 222.50.

TABLE NO. 2. Frund's New Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P. M.	2	5.30 A. M.
2	5.20 "	3	5.30 "
3	5.20 "	4	5.30 "
4	5.20 "	5	5.40 "
5	5.20 "	6	5.40 "
6	5.20 "	7	5.40 "
7	5.20 "	8	5.40 "
8	5.20 "	8	12.00 M.
9	1.40 A. M.	9	5.40 A. M.
9	5.20 P. M.	9	12.00 M.
10	5.20 "	10	"
11	5.20 "	11	"
12	5.20 "	12	"
13	5.20 "	13	"
14	5.10 "	14	"
15	5.10 "	15	"
16	5.10 "	16	"
17	5.10 "	17	"
18	5.10 "	18	"
19	5.10 "	20	12.2 A. M.
20	5.10 "	21	1.30 "
21	5.10 "	22	2.40 "
22	5.10 "	23	3.50 "
23	5.10 "	24	5.00 "
24	5.10 "	25	6.00 "
25	5.10 "	26	6.00 "
26	5.00 "	27	6.00 "
27	5.00 "	28	6.00 "
28	5.00 "	29	6.00 "
29	5.00 "	30	6.00 "
30	5.00 "	1	6.00 "

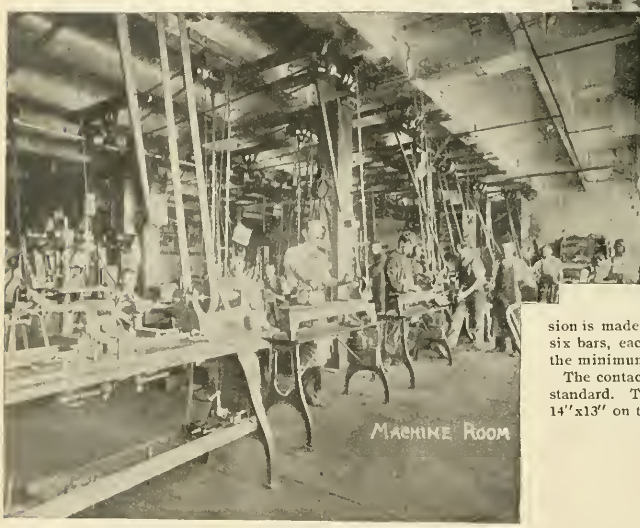
NOTE.—These schedules are made up on sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

The Iona Manufacturing Company.

Among the factors that go to make up the successive advances in the development of electrical apparatus, the improvements in the smaller detail fittings, although not as noticeable as the larger machinery to the general observer, are quite important, and as a matter of fact claim the attention of some of the most active inventors and manufacturers in the electrical field.

The Iona Manufacturing Company, of Boston, Mass., is a creditable substantiation of this statement. As is well-known, this company manufactures sockets, switches, cut-outs, and all kinds of incandescent light details. It is in the third year of its existence, is doing a large and profitable business in its particular line, and earning for itself a deservedly enviable reputation through the merits of its manufacturers and the energy and able management of its president and manager, Mr. Norman Marshall, to whom are due many of the special machines and labor saving devices employed in the conduct of its business.

In our present issue we illustrate two portions of the extensive and well-equipped factory of this establishment, which is located in the upper portion of the large 4-story building at 336 Congress street, Boston, situated near the water front and in every way well adapted for the purpose to which it is devoted. The cuts presented are almost self-explanatory, and show respectively the assembling room (where the various parts of the different devices are put together) and the general machine room. The whole of the establishment, however, could not be included in these two illustrations, which embrace also commodious



store rooms, a huge vault for the preservation of valuable dies, etc.' tubing room, buffing room, blacksmith room, dipping room for switches, and an office equipped with all modern conveniences. In fact, the establishment throughout is a veritable beehive of industry. In the machine shop, aside from the work upon special tools and machinery necessary in the manufacture of new specialties, and improved processes, brass rods and plates seem to be disappearing in all directions, and small pieces of metal formed in curious shape are dropping merrily from machines into boxes to be transferred to other machines until finally ready for the assembling room, where with wonderful rapidity, by means of innumerable screws and pieces of brass, sockets, switches and cut-outs are completed—a socket for instance going through ten different hands, each doing its part. The company is at present employing about 60 people, occupies a floor space of about 16,000 square feet, and is arranging to double its capacity during the coming month in order to carry out contracts and orders on hand. Aside from sockets and switches, the company deals in Watchmans' Electric Time Registers, Mechanical Gongs and Metal Novelties generally.

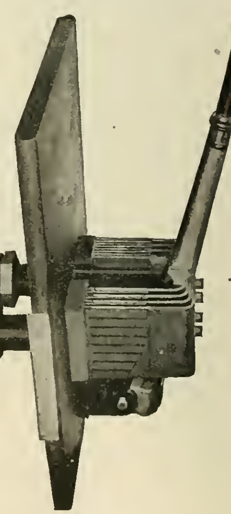
A Large Switch.

As late as April, of last year, a switch which was guaranteed to successfully rupture a circuit carrying 3,000 amperes of current at a potential of 500 volts, was considered a giant in breaking capacity, and it remained for the Ajax switch, described in the technical papers of that date, to demonstrate the utility of such large, quick break switches, and the ability to open a circuit carrying 2,000-h. p. of electrical energy at 500 volts potential, without the slightest injury to either the operator or the apparatus. During the interim, Ajax switches have been designed for 4,500 amperes (50 per cent. larger than any attempted before) and several such are in actual service on street railway circuits.

We now are enabled to illustrate another advance in switches, the one shown in the cut representing a new "plunger type" Ajax switch of 7,000 amperes capacity. This switch is guaranteed to break its full rated capacity at 500 volts potential, or nearly 4,700-h. p. It was ordered from C. S. Van Nuis, 136 Liberty Street, New York, by the Electrical Traction Company, of Philadelphia, through the General Electric Company, which is building the switchboard for the new Delaware avenue powerhouse.

Except the carrier and stand, which do not form any part of the circuit, the entire switch is made of commercially pure copper, and provision is made for clamping direct to a laminated bus bar, consisting of six bars, each 5″x¼″, or a total of 7½″ sectional area, which is also the minimum of sectional area in any part of the switch.

The contact area, finish and action are of the well known Ajax standard. The switch is compact in form and occupies a space only 14″x13″ on the switchboard. A handle of unusual length is required to



7,000-Ampere Switch.

operate these large and close fitting blades, which overhangs the switch proper several inches; the total length of the handle from the pivot is 41½″, and terminates in a highly polished piece of old mahogany. As a continuous current circuit breaker, it is believed the subject of this sketch is the largest yet attempted.

The Monocyclic Alternating System.

The General Electric Company is now placing on the market a new alternating system for simultaneous light and power work, which marks an important departure in this branch and one of much interest.

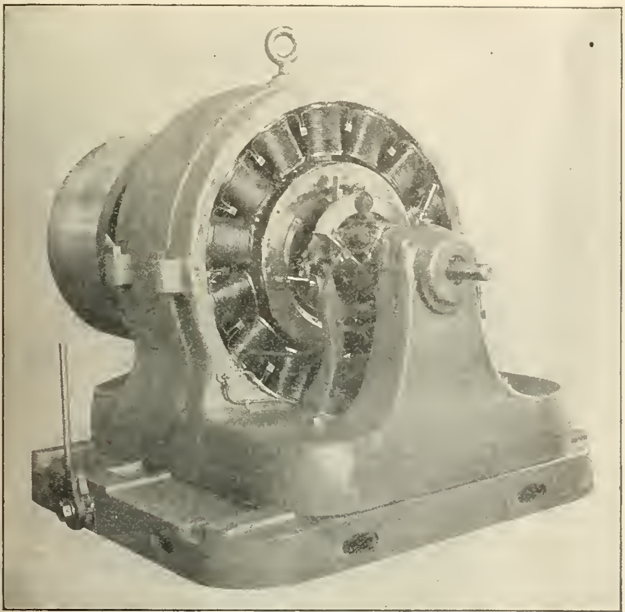


FIG. 1.—120-KW LOW FREQUENCY ALTERNATOR.

The working current is the simple alternating one; the transformers and lighting circuits are precisely the same as in the usual alternating system, and the motors are of the simple alternating (not multiphase) induction type, but with an auxiliary circuit, which constitutes the peculiarity of this system.

The monocyclic system has been devised, not for long distance power transmission, for which a three-phase arrangement of circuits is generally preferable, due to the saving of copper incident thereto, but for service of both electric lighting and power in which the importance of the former predominates. In short, the monocyclic system takes the place of the well-known high frequency system in central station work, operating transformer systems and distributing networks in the same manner, as indicated in Fig. 3.

It offers, however, over the old high frequency system the advantage of being able to supply not only light but power also, in this latter respect being equal and even superior to the continuous current system by the superior quality and reliability of the induction motor, its absence of brushes, commutators, etc., and by the flexibility of voltage incident to the use of the transformer.

While this new system can be operated in exactly the same way as the well-known high frequency system in common use nowadays, it offers in its application the essential advantage of higher efficiency and ability of supplying power. It has at the same time been specially designed for operating low tension net works on the Edison three-wire system in the same way as the continuous current lighting system, now in common use, and even with the use of the same overhead or underground mains, and offers in this case the advantage of a better balance and of a less eexpenditure in copper by replacing the heavy low tension feeders with high tension primary feeders of much less cross section, feeding into the mains by transformers. With this object in view, the generators are specially designed for parallel running, and parallel operation on a common system of bus bars is recommended in all larger stations, as shown in Fig. 3.

The frequency of the monocyclic system has been fixed at 7,200 alternations per minute or 60 cycles per second, this frequency being better adapted to the general requirements of incandescent lighting than any other, since higher frequencies occasion inductance effects in conductors, which more than outweigh the advantage gained in reduced transformer cost, while with lower frequencies, the increased cost of transformers is a serious objection. For arc lights also, this frequency is very desirable, since a lower one produces an unstable arc, and a higher frequency increases the humming incidental to alternating arcs. At 7,200, this humming noise is unappreciable. Besides, this frequency gives a convenient number of poles in motors at moderate speed, and is consequently well suited to power work, while at the same time it allows the operation of generators running at about one-half the speed of the old type high frequency alternators.

For very long distance work occasionally a frequency of 33 cycles per second or 4,000 alternations per minute is used. In this case 33 cycles have been chosen as being 10 per cent. higher than the lowest frequency at which incandescent lighting is still perfectly feasible. In general, however, 60 cycles per second or 7,200 alternations per minute are preferred as a standard frequency.

The reliability of the generators is increased by the care bestowed on the insulation, which renders the use of high voltages possible. The number of armature coils has been reduced, and these coils are machine wound, insulated, and afterwards slipped into the armature slots, thus making them easily replaceable. The generators are compounded for constant voltage under all loads, or over-compounded up to 15 per cent., to take care of the drop of voltage in the line. The bearings are both self-aligning and self-oiling, running exceptionally cool and with scarcely a tremor. Most of the machines can be arranged for direct coupling with high pressure water wheels, the larger units with turbines. All the generators have a commercial efficiency of from 90 per cent to 95 per cent. in the larger sizes. Fig. 1 illustrates a low frequency generator of 120-kw capacity.

All the low frequency alternators are fitted for use as

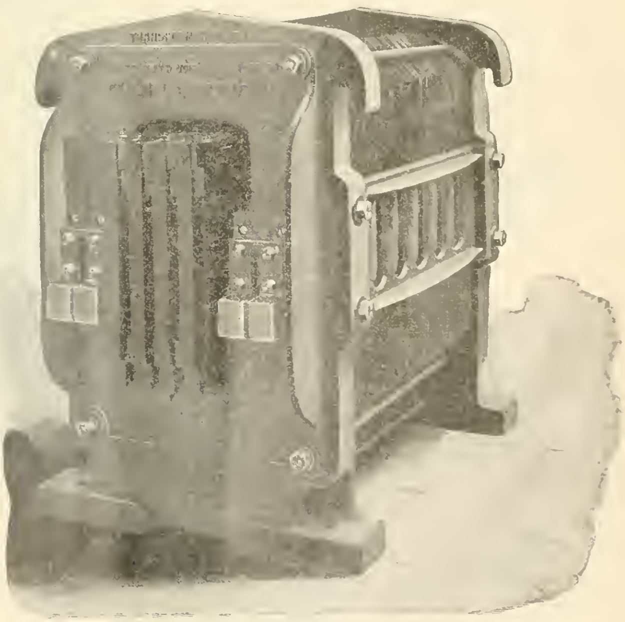


FIG. 2.—200-KW SUB-STATION TRANSFORMER.

synchronous motors; most of them will start from rest and run up to speed under light loads without the use of clutches or starting motors. They have as synchronous motors the same high efficiency as generators, and will stand heavy over-loads without falling out of synchronism. They also possess the valuable property of compensating for the

drop of voltage by the self induction of the line, and for idle currents by their action as condensers.

The transformers employed in the monocyclic system are designed for frequencies between 33 and 60 cycles, and thus can be operated not only at the standard frequency of 60 cycles, but also in those cases where for long distance work 33 cycles have been chosen. All these transformers are oil-insulated. Sub-station transformers have also been designed for larger units, especially for power transmission work where the transformer units may be banked in groups of large output. They are specially suited for step up and step down work and for all sub-station distribution. They are without oil insulation, the coils being so insulated as to render this precaution unnecessary. They are thoroughly ventilated, and each bank is provided with one or more ventilating blowers, passing a draft of cool air through them. The efficiency of these transformers is very high, notwithstanding the decreased frequency, owing to the care used in selecting the iron, and ranges from 96.5 per cent. to 98 per cent., and even higher in very large units. Fig. 2 illustrates a 200-kw sub-station transformer.

As before said, the lighting system is operated in the same way as with the old alternators, by two wires and one transformer, which supplies a two-wire or an Edison three-wire system from its secondary terminals. From the same mains, however, motors are operated, and in this case two transformers are used, connected between the main wires and a supplementary or power wire; in which, by the action of the motors, an intermediate but laterally displaced voltage is established and maintained. For this purpose, the generator armature contains, besides the main coil, a small supplementary or teaser coil, which is connected with one end to the centre of the main coil, while the other end is lead to a third collector ring. It is obvious that this third collector ring is used only for supplying motors, while the lighting current passes exclusively

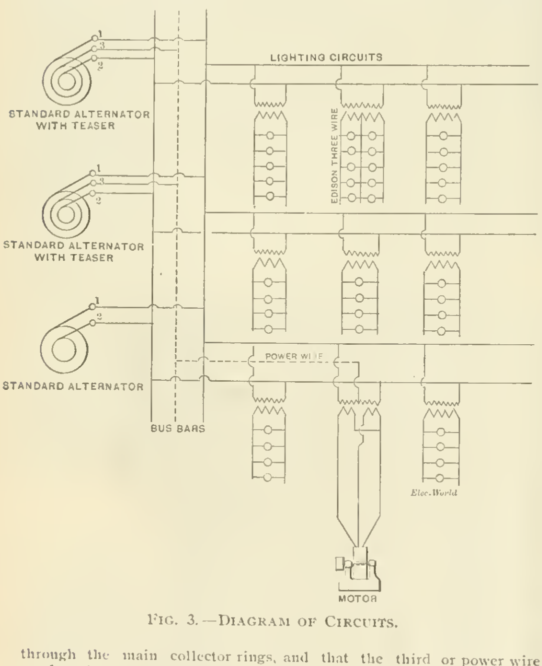


FIG. 3.—DIAGRAM OF CIRCUITS.

through the main collector rings, and that the third or power wire needs to be carried only to where motors are located, and, since it does not convey large currents, needs to have a small cross section only. Fig. 3 shows the different connections possible to the circuit.

The most interesting feature of this monocyclic system is the monocyclic induction motor operated therefrom. As our readers are aware, an induction motor is one with a closed circuit armature having no connections with the supply circuit. Such a motor, however can, with a simple alternating current of the old type of machine, not start of itself from the rest under full load without excessive current. This difficulty has been overcome in the new monocyclic motor, which in its action is essentially identical with the best three-phase motors built. It has a closed circuit armature wound with a small number of heavy copper bars of low resistance, and a starting rheostat is placed within the armature spider. At starting, a collar sliding along the shaft is kept out of contact with the switch used to short circuit the resistance, but when the motor is approaching full speed, the contact ring is moved along the armature shaft until the armature is short circuited on itself. Thus a very large starting effort is obtained, with the current limited to a reasonable amount by resistance.

In all the standard induction motors, the starting resistance is adjusted so as to give a starting torque 50 per cent. in excess to the running torque at full load, and requiring therefor an excess of 50 per cent. of current over full load current. By special adjustment of the starting resistance, the starting current can be limited in any desired manner, reducing, however, the starting effort proportionally, while a very large starting effort of 10 or more times the running torque, can be secured, by a corresponding expenditure of current, however.

The field winding of the motor is very similar to that of the three-phase induction motor, with the difference, however, that only two of the three terminals are connected with the main lines, while the third terminals are connected with each other and with the teaser coil of the generator, by the intervention of transformers.

The result of this arrangement is that in this teaser or power wire an exchange of current takes place between the different motors and the generator, in a similar manner as in the neutral wire of the Edison three-wire system. Thus the power wire does not carry large energy currents, but only the magnetizing currents of the motors, acting as an equalizing connection between them, and needs to have a small cross section only.

The New Wood Iron Clad Alternator.

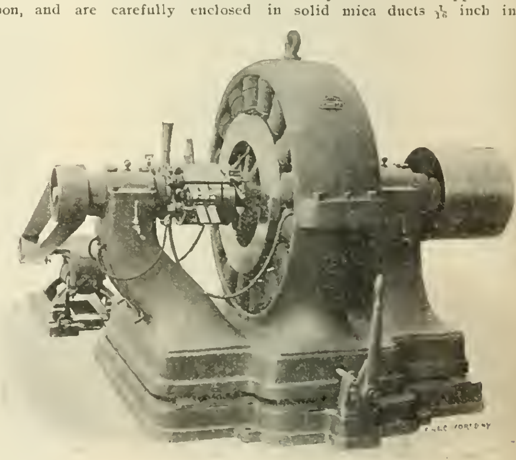
In our issues of June 23 and June 30 we described the new types of apparatus of the Fort Wayne Electric Corporation, Fort Wayne, Ind., and are enabled now to add some further details in regard to the new Wood iron clad alternator.

In the design of this machine, two points have been aimed at, reduction in amount of material and in speed at which the machine will operate. The new Wood alternator runs 350 revolutions slower than the former type, and has 1,000 pounds less copper wire on it, and complete weighs 650 pounds less.

The bed plate is cast in one piece. The pedestals carrying the bearings are massive, and well able to take care of the strain imposed upon them. The bearings proper, which are of bronze, are mounted in flexible iron sockets giving elasticity, and rendering the boxes free to expand in case of heating.

The field magnets are of cast iron, being in the form of a ring with inwardly projecting pole pieces, which are slotted in order to prevent eddy currents being generated in their faces. Over these pole pieces are compound coils of copper wire; each of these is composed of four layers of a comparatively small wire and connected in series with the exciting dynamo, over which are wound two layers of heavy wire through which the rectified portion of the main current passes. By this method of compensation or over-compounding any line loss is made good, automatically and instantaneously.

The armature of this alternator is a new departure, being made up of C-shaped stampings, which construction introduces an economy by enabling scrap stampings to be used, and provides an enormous radiating surface. The coils consist of a very few turns of copper ribbon, and are carefully enclosed in solid mica ducts $\frac{1}{16}$ inch in



IRON CLAD ALTERNATOR.

thickness and set well below the surface, making it impossible for the coil to fly out under any circumstances, and obviating damage from bands or external fastenings becoming loose. The insulation of each coil is carefully tested with 5,000 volts alternating current between the coil and the core before the armature is placed in the fields for final test. The number of turns per coil has been made as small as possible, but at the same time the volts per inch have been increased as much as possible, and the armature induction carried to the highest practical point—to 8 kilogausses. As a result, one volt is produced for every 3.6 inches of armature conductor. In spite of this, however, the armature runs practically cold on a continuous run with a full load. This result is

undoubtedly due to the peculiar construction of the armature core, which is not built up of rings or segments as has been customary in all previous dynamos, but, as stated before, of C-shaped stampings which are put together like a link belt, only that the laminæ do not register with one another, but are stacked in sets; this leaves air spaces not only between themselves, but also air ducts around the active coils, formed by the failure of the punchings to register correctly, as above stated. This construction gives a large radiating surface, equal to about forty times the actual surface of the armature, and as the armature rotates powerful air currents are circulated through its sieve-like periphery, causing the core to run very cool. The one end of the armature coils is connected to one of the collecting rings, while the other end is connected to one side of the commutator, the other commutator segment and remaining collecting ring being connected together. When the brushes are properly placed on the commutator and rings, and the proper external connections are made, the main current, or a portion of it, is rectified and sent through the series coils of the field, in order to compensate for drop in the external circuit.

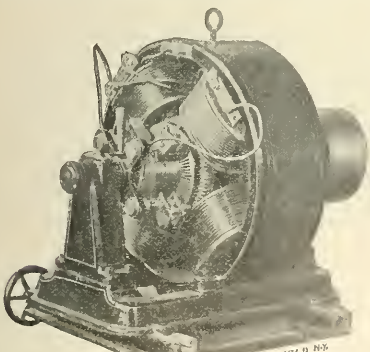
The initial excitation is produced by an exciter which accompanies the alternator, and which is also of the slow speed type with an iron clad armature, and gives practically constant potential on all changes of load. It also has a maximum capacity of double the current required to excite the alternator which it accompanies, thus giving a considerable working margin.

The construction of the brush yoke on this machine is also a new departure, the yoke being made somewhat less than a half circle, and placed below the centre of the shaft, and adjusted from an independent pedestal. The advantage of this arrangement is that it permits the removal of the armature without disconnecting the yokes, brush holders or connections. The field shunt, or non-inductive resistance, is hung inside the pedestal, where it is removed from all danger of destruction or alteration, and is ventilated by a forced draught from the armature, which is carried in ducts cast in the main frame of the machine. This pedestal has a perforated removable door, from which the shunt may be inspected from time to time. A sliding base also accompanies these alternators, which not only enables the attendant to move the dynamo, so as to properly adjust the belt, but at the same time move the exciter, so that the tension of the exciter belt is not altered in changes of position of the alternator. This is a very convenient improvement, as it enables this part of the work to be done quickly and by one man. On the commutator two sets of brushes are used, each side in multiple, so that one set can be removed for trimming while the machine is in operation. On the collecting rings of the large size alternator, two sets of brushes are used in tandem, so as to give increased carrying capacity, and also admit of the removal of one brush, if necessary from any cause.

A New Multipolar Dynamo.

We illustrate in the accompanying cut the multipolar dynamo and motor of the Electrical Mfg. Co., Dr. G. H. Zahn, Corry, Pa. As will be readily seen, great care has been given to produce an artistic design, a solidity of construction and a close adjustment of proportions within the machine.

The magnet frame is of the ring shape and cast in one piece, insuring a good magnetic circuit and great mechanical strength. The armature is of the Gramme ring type, and carefully annealed sheet iron rings of the best quality are used in building up the core. These rings after being



MULTIPOLAR DYNAMO.

insulated are clamped between two halves of a bronze spider, held together by steel bolts in the interior of the core. The commutator is of very massive design, made of tempered copper and insulated with mica exclusively. The shaft, of the best machinery steel, runs in self-oiling phospher bronze bearings.

The new line of standard machines brought out by this company are of high efficiency and guaranteed to be free from defects in workmanship and material and to run with perfect automatic regulation without any sparking and injurious heating.

New Arc Lamps.

The lamp which we illustrate, manufactured by Auerbach-Woolverton Electric Company, Broadway and Houston street, New York, is a wide departure from the usual form of arc lamps. The lamp comolete measures but 18 inches from the top to the bottom, including the globe, and therefore is particularly adaptable to ornamental treatment. It is

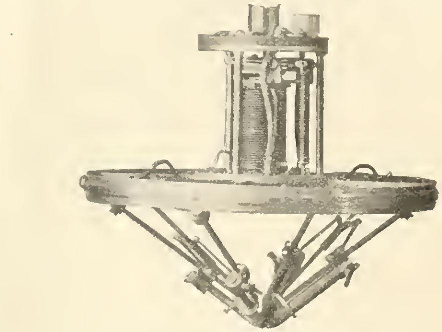


FIG. 1.—MECHANISM OF LAMP.

claimed that the carbons have a life of 25 hours in the open air. Owing to the disposition of the carbons, the arc is constant in position, all the light is thrown toward the ground, and there are no shadows whatever cast.

The only mechanism about the lamp, except the gravity feed, is that connected with the single magnet shown, and this is only used to strike the arc. The two positive and two negative carbons are respectively held in two inclined frames, one of which is rigid and the other one hinged in order to enable the arc to be struck. The carbons are fed by gravity, each carbon holder being guided by two rods in the inclined frame. To insure uniformity of feeding the carbon holders of each pair

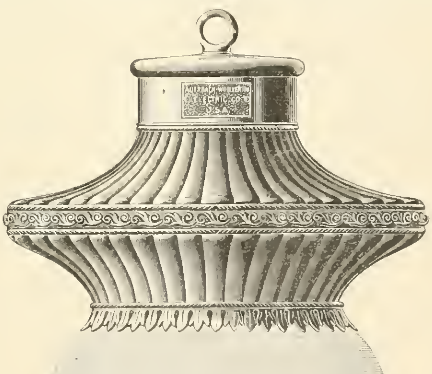


FIG. 2.—LAMP COMPLETE.

are connected by levers pivoted to a central part, which slides along a guide rod as the carbons are fed; by this means each carbon of a pair is advanced at exactly the same rate. When out of circuit the carbons are in contact, but when the lamp is switched into circuit the central magnet shown strikes the arc. As the carbons are consumed they are fed down by gravity, the ends of the positives or the negatives respectively always being together, thus maintaining constant the distance between the positive pair and the negative pair. From this it will be seen that the magnet plays no part in feeding, its function in the high tension lamp illustrated being merely to strike the arc; in the low tension lamp, however, there is a regulating magnet.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 6, 1894.

THE ELECTRICAL STOCK MARKET during the financial week ending to-day has been rather irregular in its movement. Trading proclivities are still on the bear tack, and Wall street sentiment is accordingly still averse to any boom in stocks of any kind, but the favorable circumstances connected with one or two companies have made their stock and bond issues act independently of the general market, so that some quotations in the appended table are higher.

GENERAL ELECTRIC'S quotations, as a result of the week's trading, are practically unchanged. The stock seems to have settled down betweens 35 and 40, but at these figures prices are held with a tenacity that betoken a deal of restored confidence in the company's condition. Severe attacks have been made on the stock during the week and the most aggressive of the bear clique have put forth their powers in an attempt to locate its quotation, putting into circulation all sorts of stories about defective apparatus being returned by customers, treasury assets being sold, etc. They have not, however, met with any degree of appreciable success; all the adverse stories have met with prompt official denial, while, on the other hand, there is plenty of gossip of a favorable character to more than offset the bad feeling created by the spreading of the ill-natured reports above referred to. Here is the way one authority on General Electric is quoted as expressing himself: "General Electric is worth present prices, because it is doing a profitable business. The company earned all its fixed charges for the year in the first six months and is profiting greatly at present by the disablement of the Siemens-Halske Company as a consequence of the recent fire. The one great bar to anything like an important advance in the stock is the fact that dividends are necessarily a long way off, while on the other hand a good guarantee against any decline is the fact that the company is doing a large business on a sound basis and is earning considerably more than its fixed charges." The company is still retiring its 5 per cent. bonds with such funds as become available from time to time; it is estimated that between $600,000 and $700,000 have so far been brought back, so that they now figure as treasury assets. These purchases have been made without sales to any considerable extent of treasury assets, though there are securities in the treasury available, as, for instance, some 2,500 shares of New York Edison Illuminating Company stock and other equally as good assets. The directors are not, however, in a hurry to sell any of these.

WESTERN UNION TELEGRAPH stock is up a little, though bear raids have made it lose most of its gain. The attempt to bear the stock by selling it short has again proven futile. As has been repeatedly pointed out in these columns, the floating supply is so small as to make it impossible to cover a large short interest, and the minute that does assume decent proportions the risk becomes too great to admit of further bear operations. There is some talk of further fresh opposition to Western Union springing up, but it is not stated just how this is to be done. The indefiniteness of the threat, therefore, fully destroys its force. People generally well informed as to the affairs of Western Union know nothing of this rumored paper competition. On the other hand they tell that business keeps right on picking up, earnings for the quarter ended September 30 being understood to be nearly $100,000 better than the estimate.

WESTINGHOUSE ELECTRIC issues fail in developments. There is nothing new regarding the company's financial affairs or prospects than was herein outlined last week. Quite a steady demand keeps up for the common stock, yet it is pronounced enough, from a stock market view, to make the stock conspicuous by reason of its activity. Quotations, however, hold excellently, the reports of business fully warranting the existing level of prices.

AMERICAN BELL TELEPHONE matters, as hinted at a week ago, promise important developments at an early date. It is understood, according to information from Boston, that the Board of Directors will, at the October meeting, next week, take up the question of the future policy of the company in relation to long distance extensions. These would have been farther advanced at this day had the Massachusetts legislation of last winter been less restrictive. Nothing further is heard of the Bell Company's supposed ally in this State, the Standard Telephone Company, whose final incorporation was recorded Friday, but it is now generally believed that something will come of the matter. Bell Telephone is now recognized as a 15 per cent. stock, so that its quotation, 202, ex-dividend, is rather low.

THE NEW YORK EASTERN TELEPHONE COMPANY, which recently got a franchise from the aldermen of Brooklyn, N. Y., is about to offer its bonds to the investing public. The company agrees to pay the city 1 per cent. of its gross receipts every six months; to furnish the city with telephone service at a price for each instrument not exceeding $40 per annum and to the general public at a price not to exceed $75 per year. Investors should bear in mind, however, that a question as to the validity of the franchise has been raised, and, until the matter has been settled by the courts, it will be well to let the bonds severely alone.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES is buying in as much more of its preferred stock issue as $50,000 will purchase. Proposals for sale will be opened by the trustees on Monday next.

THE ERIE TELEGRAPH AND TELEHPONE COMPANY announces that it has appointed as New York transfer agent the New York Guarantee and Indemnity Company, with the Seaboard National Bank as registrar. The Old Colony Trust Company and the Globe National Bank will respectively act as the Boston transfer agent and registrar for the company.

THE INTERIOR CONDUIT AND INSULATION COMPANY'S quotations, despite the general good business transacted by this company for the past few months, are still inclined to drop, that is so far as outside trading is concerned. Brokers report the stock as offered at 35, which is 10 points below the quotations of a week ago. It is thought stock prices were forced above current market figures, so that a retrogression is natural. Officials of the company are, however, well satisfied with its status.

"Asterisks," as indicating ex-dividend, are becoming more numerous in the Electrical World's table of quotations. These "marks of honor" tell the story of what electrical stocks are doing. To the quotations so marked this week there should be added New York Edison Electric Illuminating and Brooklyn Edison Electric Illuminating, which have declared dividends, but whose books are not yet closed. Boston, Chicago and Philadelphia illuminating properties will also soon be quoted ex-dividend.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101½	102¼
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	38¼	38½
General Electric pref	100	70	72
Interior Conduit & Ins. Co.	100	25	35
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	34½	35½
* " " pref	50	52	53

BONDS.

	Par.	Bid.	Asked
*Edison Electric Ill., New York	1,000	107⅛	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
*American Bell Telephone	100	200	202
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	105	110
*Commercial Cables	100	125	145
Erie Telephone	100	51	52
Gold & Stock Telegraph	100	102	105
*Mexican Telegraph	100	180	190
New England Telephone	100	67	69
Postal Telegraph-Cable	100	50	60
*Western Union Telegraph	100	89⅛	89¼

* Ex-div.

NEW INCORPORATIONS.

THE NORTHERN ELECTRIC COMPANY, Chicago, Ill, capital stock $25,000, has been incorporated by Joseph Kettlestrings, Geo. W. Furbeck and W. I. Marshall.

THE BELVIDERE TELEPHONE COMPANY, Belvidere, Ill., has been incorporated by W. M. Moreau, Omer H. Wright, Jr., Jno. B. Tripp and J. B. Balliet. The capital stock is $5,000.

THE ARCTIC FAN COMPANY, Baltimore, Md., capital stock $50,000, has been incorporated by Geo. W. Smith, Jno. B. Maloney, Jno. W. Hartsell, Harry O. Hartsell and Harry Tilghman, to manufacture electrical and other novelties.

THE MISSOURI DISTRICT TELEGRAPH COMPANY, St. Louis, Mo., capital stock $250,000, has been incorporated by L. C. Baker, R. H. Bohle, C. J. Frankel, C. H. Bristol and J. W. Jones, all of St. Louis, for the purpose of constructing and operating magnetic telegraph lines.

THE CONSUMERS' ELECTRIC LIGHT COMPANY, Pana, Ill., capital stock $5,000, has been incorporated to furnish electric light, heat and power. O. H Paddock, D. J. Overholt, J. C. McQuigg, W. W. Morrison, J. L Connor, Aug. Reher and John Kuhn are interested.

THE INDEPENDENT ILLUMINATING COMPANY, Chicago, Ill., capital stock $10,000, has been formed to generate and supply electricity, also to make and sell gas, etc., for heating and lighting purposes, power, etc. Christopher Treilbec, John McMillin and George Ham are interested.

THE TEXAS PACIFIC MANUFACTURING COMPANY, of Fort Worth, Tex., Tarrant County has organized for the purpose of maintaining and constructing a telegraph and telpehone line and to manufacture and supply light to the public. The capital stock is $20,000, and the directors are R. D. Hunter and H. C. Huntington, of Fort Worth; C. V. Sidell, 146 Broadway, New York City, and others.

THE PRAIRIE STATE CONSTRUCTION COMPANY, Chicago, Ill., capital stock $500,000, has been formed to build railways, erect and maintain electric plants, to supply light, heat and power, and to operate telegraph and telephone lines. Hosea W. Wells, V. H. Surghnor and E. A. Maynard are the incorporators.

THE ELECTRIC MATCH AND ADVERTISING COMPANY, Cincinnati, O., capital stock $10,000, has been formed to sell, hire and lease mechanical electrical devices used for advertising purposes, and as cigar lighters, etc. Talton Embry, George Slimer, Joseph T. Homan, O. J. Wiggins and Wm. Montgomery are the promoters.

THE PACIFIC ELECTRICAL COMPANY, San Francisco, Cal., capital stock $30,000, has been formed to deal in and manufacture electrical and other goods and do a general manufacturing and construction business. W. S. Beckwith, Piedmont Springs; I. E. Richey, Oakland; E. H. Kimball, John T. Hogan and Geo. A. Clough, of San Francisco, Cal., are interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 Broadway, NEW YORK, Oct. 8, 1894.

CHEAP TELEPHONE SERVICE.—Mr. Dwight W. Curtis, a member of the Produce Exchange, is president of a company which proposes to supply a New York telephone service for $2 per month.

AT A MEETING of the Brooklyn Bridge Trustees, Mr. Keeney moved to adopt electricity as a means of illumination in place of the present system. The Mayor seconded the motion, and every member of the board present, Mr. Skinner excepted, voted in the affirmative.

THE STATE ELECTRIC LIGHT & POWER COMPANY, of Brooklyn, has filed with the Secretary of State a certificate of an increase of cash capital from $200,000 to $500,000. The principal office of the company is at 74 Broadway, Brooklyn, N. Y. Noah I. Cochen is the president and Wm. Seward the treasurer.

MR. WM. S. BARSTOW, of the Brooklyn Edison Illuminating Company was married on Oct. 4, to Miss Francoise Du Clos at New Brunswick, N. J. A silver dinner service, consisting of 143 pieces, was presented by the Edison Illuminating employees in Brooklyn and the directors of the Illuminating Company presented the bridegroom with a loving cup. The young couple have the most cordial wishes of the electrical fraternity for a long life of happiness.

INVISIBLE WIRES.—At the meeting of the Board of Electric Control last week several specimens of wire were exhibited that had formed part of overhead lines strung in violation of law, and which had escaped detection by being almost invisible a short distance away. There were seven different kinds of wires used. One was a thin but shiny copper wire, another was the thin green silk covered article, and a third was a dark gray that was almost indiscernible ten feet away. These wires were found by the inspectors only after the greatest trouble. Several of them were traced from 55 and 57 Broadway to the Tower Building, and thence to 1 Broadway. The wires were dropped from the flue of 1 Broadway, where further tracing could not be had.

NEW ENGLAND NOTE.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, October 6, 1894.

THE CITY FATHERS are taking means to have the unused tracks of the West End Street Railway, removed from the streets of Boston. They say that dead wires and unused tracks must go.

BROCKTON, MASS.—Mayor Whipple and his Board of Aldermen are to provide a plan which shall place all telephone wires underground.

NEW HAVEN, CONN.—At the annual meeting of the New England Telephone Company's Mutual Benefit Association, W. A. Hurd, of Hartford, was elected president, E. A. Smith, of Meriden, vice-president, F. P. Lewis, of New Haven, secretary, and F. H. Embler, of New Haven, treasurer.

A TERRIBLE ACCIDENT.—C. E. Day, a trimmer for the Boston Electric Light Company, was killed on Oct. 4, while replacing the carbons in a lamp at the corner of Channing and Congress streets, and A. J. Monroe, another employee of the company, was fatally injured while endeavoring to assist him from his perilous position. It was an awful spectacle, and was witnessed by hundreds of horrified spectators, who were unable to do anything for Day's relief, and who were compelled, much against their will, to stand in the street and watch him slowly roast to death..

CANADIAN NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Oct. 1, 1894.

OTTAWA, Oct. 4th.

TORONTO.—The receipts of the Street Railway Company for last month were the largest in the history of the Company, and amounted to $104,152.21, as against $92,745.87 for the corresponding month of last year.

BROCKVILLE, ONT.—A war between rival telephone companies is threatened in Dundas county. The new company in oppositiion to the Bell Telephone Company are putting in instruments for $10 a year.

ST. THOMAS, ONT.—The St. Thomas Street Railway has been sold to the syndicate which controls the Toronto, London, Cleveland, Montreal, St. John and Winnipeg systems. The line will be extended and converted into an electric service.

OTTAWA, ONT.—The act passed last session respecting the inspection of electric lights, provided that so soon as the standards and apparatus had been acquired, the Government might issue a proclamation fixing the date upon which the act should go in force. The standards and apparatus have arrived and been installed in the Standard's branch of the Department of Inland Revenue. Consequently a proclamation was issued on Saturday, declaring that the act shall come into force in Canada on the 1st of April, 1895. Inspectors have not yet been appointed but it is understood that Mr. O. Higman, who has been retained by the Government as electrical expert, will shortly proceed with the instruction of the present inspectors of gas and measure in the intricacies of electric standards. It is claimed the inspection of electric lighting can be done after a litt lepractice by anybody accustomed to the work of gas inspection.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, September 26, 1894.

EARTH CHARGING BY HIGH PRESSURE ALTERNATE CURRENT MAINS.—In January last a grey mare was killed at Bournemouth by an electric shock. Owing to the mysterious manner in which this unfortunate animal met its death, the Town Council of Bournemouth thought it necessary to wire to the Board of Trade to send down one of their inspectors to investigate the whole matter. The inspector reported that the cause of the accident was that there was a defect in the insulation of one of the 2,000 volt mains, that this main came in contact with the enclosing wrought iron pipe, which was laid under the roadway at a depth of 18 inches and terminated at a *brick* junction box, and that in consequence the earth became charged on either side of the junction box to such an extent that between the fore and hind legs of the grey mare a sufficient difference of potential was established to give rise to the current which proved fatal to it. In a paper recently presented to the Royal Society on "The Difference of Potential that may be Established at the Surface of the Ground Immediately Above and at Various Distances from a Buried Mass of Metal Charged from a High Pressure Electric Light Supply," and the Board of Trade inspector (Major Cardew) gives the result of three experiments carried out by him at Chatham with a view to further elucidating the matter; the case of a death following from a simple contact with ordinary road material being a new experience of the possible dangers attending a commercial supply of electrical energy. Major Cardew concludes from his experiments that under very different conditions of weather and amount of moisture in the soil, it is possible to produce a difference of potential amounting to 25 per cent. of the total pressure, between points on the surface of the ground 4 ft. apart. Alternate currents alone were used in these experiments, but it is proposed at an early date to repeat these experiments with continuous currents. The following curious note is made by the author in the course of his paper: "The soil in which the pipe was buried was loamy, and when digging the trench no worms were noticed, but towards the conclusion of the experiments it was observed that hundreds of worms came to the surface, between three feet and nine feet on either side of the buried pipe; no worms appeared, however, immediately over the surface of the pipe." In another part of his paper, the author, speaking of another experiment, remarks. "The disturbance of the worms was again very distinct, and they appeared, on reaching the surface, to set their bodies parallel to the pipe or along the equipotential lines." It would appear from this remark as if the author contemplated mapping out lines of current-flow by means of worms, which it is to be hoped will prove amenable to electricity, as are iron filings to magnetism.

News of the Week.

TELEGRAPH AND TELEPHONE.

ASHEVILLE, N. C.—A company has been formed to construct a telephone system from Asheville to Weaverville.

CHARLESTOWN, W. VA.—William Campbell is in the market for a telephone equipment to connect half a dozen points a quarter of a mile apart.

ST. JOSEPH, MO.—A conduit franchise asked for by the Missouri & Kansas Telephone Company has been referred to a committee of the Council, but has not yet come up for a final issue.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY gave a reception at Terre Haute, Ind., upon the opening of its long distance lines connecting that city with the principal cities of the East and West. Mr. W. A. Vail, of the New York office, H. J. Curl of the Pittsburg office, Mr. Geo. C. Brooks, of the Chicago office, and Mr. John H. Cross, of the Cincinnati office, were among those present.

OYSTER BAY, L.I., N.Y.—Articles of incorporation have beeen filed with the Secretary of State at Albany, for a company styled the Long Island Co-operative Telephone Co., with a capital stock of $20,000. The plans were originated by Dr. Mann, of Jericho, Dr. Geo. W. Faller, of Oyster Bay, and Wilbur Johnson, of East Norwich, and its purpose is to extend facilities for communication by telephone throughout Long Island. Another meeting will be held at the Town Hall at Oyster Bay.

ELECTRIC LIGHT AND POWER.

GERVAIS, ORE.—The village is figuring on the expense of an electric light plant.

ELBERTON, GA.—Address the Mayor regarding the erection of an electric light plant.

LISBON, IOWA.—The Council will receive bids for putting in an electric light plant.

HUDSON, MASS.—Address Francis Brigham with estimates of the cost of an isolated electric light plant.

AMERICUS, GA.—This city is considering the erection of an electric light plant. The Mayor may be addressed.

ANNISTON, ALA.—The Anniston, Gas and Electric Company is reported to have asked for an extension of time.

ALBERT LEA, MINN.—The Committee on Electric Lights was authorized to advertise for bids for electric lighting.

SEYMOUR, IND.—The Council will receive bids for lighting the streets by gas or electricity. J. E. McKinney is city clerk.

NEW ORLEANS, LA.—The Louisiana Electric Light Company is considering the erection of a power station for electric car service.

PALATKA, FLA.—The electric light company represented by E. E. Haskell, has been granted a franchise to erect a plant in Palatka.

GRAND RAPIDS, MICH.—A resolution is before the Council to vote on an issue of $150,000 in bonds to purchase an electric light plant.

WAPAKONETA, OHIO.—An election will be held Nov. 6, to vote on the question of issuing $5,000 electric light bonds. Joseph Myers is clerk.

SHIPPENSBURG, PA.—The contract for lighting has been awarded to the Shippensburg Electric Light Company. Its bid was $1,500 per annum.

ASHLAND, KY.—A movement is on foot for the organization of a company to establish an electric light plant. A capital stock of $8,000 is proposed.

MERIDEN, MISS.—The Meriden Gas Light Company has awarded a contract to C. M. Rubush for the erection of its new electric plant, to replace the one recently burned.

CHARLOTTE, N. C.—The Charlotte Consolidated Construction Company will put in a complete incandescent system for lighting the city of Charlotte, in its plant at Dilworth.

STERLING, ILL.—Sealed proposals will be received until October 15 for lighting the city for a period of ten years by electricity. Bids to be received by the City Council.

CARROLLTON, GA.—Cliff Turner intends to remove his electric plant from Carrollton, and it is expected that a company will be formed to purchase same so that it will remain in the city.

PITTSBURG, PA.—The North Sub-District School, of the Fourth Ward, is to have an electric light plant, the power for which is furnished by an engine built by the Ball Engine Company Erie, Pa.

ST. JOSEPH, MO.—The Sommer-Richardson factory of the American Biscuit Co., is putting in a 500-light plant; the C. & C. apparatus is being installed and the construction work done by the Columbian Electrical Co.

KEENE, N. H.—The Keene Gas Light Company is to build an electric lighting station at Spragueville. It will have five dynamos, and a powerful steam engine to use, if necessary, to supplement the two turbine water wheels.

NEW YORK CITY, N. Y.—At a meeting of Park Commissioners, the question of lighting Central Park by electricity was brought up. President Clausen said that the matter required so much discussion that he did not wish to make up, a hasty estimate.

PENSACOLA, FLA.—L. C. Sarra has been awarded a contract for the erection of an electric light plant by the new Citizens' Electric Light & Power Company. The machinery will include a 1,500-light incandescent dynamo and a 100-light arc dynamo.

POTTSDAM, N. Y.—At a meeting of the Electric Light Company a committee was appointed to secure a site for and erect a building, if it should be deemed advisable, at a cost not to exceed $15,000. The company proposes to erect a handsome fire-proof building.

PEORIA, ILL.—At the last meeting of the Board of Supervisors, J. D. McClure, J. V. Schmidt and George C. Murray, with Thos. Clinch, chairman, were made a committee to look after the matter of establishing an electric light light for county purposes, together with providing motive power for the court house elevator.

FALLS CITY, NEB.—At a meeting of the City Council of Falls City it was decided to close down the electric light plant, which belongs to the City, indefinitely. This action was caused by a report of a special committee appointed to examine the condition of the plant. The report says that the engines are in bad condition and not capable of running the lights.

OAKLAND, CAL.—The death of Mr. Van Leer Eastland, superintendent and general manager of the Oakland Gas, Light and Heat Company, removes one of the pioneers of the Pacific Coast in the branch of business with which he was so long identified. Mr. Eastland entered the employ of the San Francisco Gas Light Company in 1854, and was connected with the Oakland Company 27 years.

KINGSTON, N. Y.—The lamp committee of the Common Council, consisting of Aldermen Hamburger, Breitenbucher and Lundy, met at the city hall, and examined the plans for the electric light plant, which were submitted to them by Geo. F. Woolson, of New York, a representative of the Chicago Standard Arc Light Mfg. Co. The plant specified in the plans would cost about $45,000. They will meet again to discuss the matter.

DAVENPORT, IOWA.—A resolution introduced by Alderman Parkhurst was adopted providing that the Committee on Light and Finance and the Commissioner of the Board of Public Works be authorized to gather data relative to the cost of maintaining electric light plants in cities of the size of Davenport. The object of the investigation is to determine whether it is cheaper for the city to rect a plant or to depend on private enterprise.

HEMPSTEAD, N. Y.—The Board of Trustees of the village of Hempstead have called a special election to determine the question of lighting the streets with arc lights. There will be three different propositions to vote upon, from the Hempstead Gas Light Company, for 70 lights, at $84 per light per year; F.W. Werner, 70 lights, at $80 per light, and G. W. Graham, 70 lights, at $85 per light. All bids are for 800-candle power, the contract to run for five years.

DETROIT, MICH.—The trustees of Highland Park have granted to a syndicate, represented by Howie Muir, a thirty-year franchise for a street railway along Tuxedo avenue from Woodland avenue to Hamilton avenue, north to the six-mile road. Mr. Muir says that a modern street electric railway will be constructed. It is claimed that the object of the new company is to build up land owned by the syndicate and at the same time give the public facilities for visiting Palmer Park.

SPRINGFIELD, ILL.—The City Council voted unanimously to accept the proposition of the newly organized Citizen's Light Company for the construction of a municipal electric light plant for the city. The company is to construct immediately a plant to furnish more than twice as many arc lights as are now in use and is to receive the appropriations made now for street lighting purposes for five years. Then the plant is to be turned over to the city and is to be operated by it. Jos. C. Klaholt and E. D. Keys are the directors.

The Electric Railway.

MACON, GA.—The City & Suburban Railway Company may extend its line to the suburbs

INDIANAPOLIS, IND.—An ordinance providing for the extension of the City Railway Company's lines was adopted.

HILLSBORO, TEXAS.—J. W. Maxwell and others are interested in a proposed electric line from the city to Rose Hill suburb.

NEW ORLEANS, LA.—The Carrollton Railway Company's Canal street division is to be rebuilt for electrical motors. Jos. Lennes is president.

HOUSTON, TEXAS.—The Houston & Suburban Railway Company has awarded no contracts as yet for building its road. E. W. Cave is interested.

DEPOSIT, N. Y.—An electric railroad is projected between Deposit and Trout Creek. It is said that the New York Condensed Milk Co., is backing the scheme

NEWTON, MASS.—The Newton Street Railway Company's directors have decided to make another extension of their line in Waltham. The line will be built this fall.

NEWARK, N. J.—The freeholders of Essex and Hudson have granted permission for an electric system to be used on the Clay street and Harrison avenue bridges.

CAMDEN, N. J.—The Camden Horse Railway Company has recently placed an order for two 350-hp Vertical Compound engines with the Ball Engine Company, Erie, Pa.

SOUTH WINDSOR, CONN.—At a hearing of the selectmen the petition of the president and directors of the Hartford Street Railway Co., to lay tracks for electric cars in that town was granted.

MIDDLETOWN, CONN.—Israel A. Kelsey, of this city, and A. C. Pond, of Boston, have bought the Middletown street railway, and will at once equip the property with the trolley system. The company will issue bonds.

LOWELL, MASS.—The Lowell & Suburban Railway Company will next year extend its lines to Mountain Rock Grove, where the company proposes to lay a half mile bicycle track and build a grand stand to accommodate 500 people.

SAN BERNARD, COL.—The Bear Valley Reservoir Company, A. P. McGinnis, receiver, will erect a new dam and reservoir. The company proposes to operate a car line and works with electricity developed by water power.

MANITOU, COL.—Arrangements are being made to build an electric road over Ruxton avenue to Iron Springs. The plant will be operated by water power. The capital is $45,000. M. A. Leddy is president and John Hurlburt secretary.

WASHINGTON, D. C.—The Metropolitan Railway Company will probably use an underground electric system on its Ninth street division. Seven miles of track and conduit will be required and motors specially built. A. N. Connett is engineer, and Samuel Phillips, president.

BALTIMORE, MD.—The electric railway which will run between Baltimore and Washington will soon be built, it is said. Surveyors have completed their survey of the line between Riverdale and Washington. The road will approach Washington via Hyattsville. David M. Newbold is interested.

CHICAGO, ILL.—The General Street Railway Company, in which Harry McCann is largely interested, has taken out a building permit to erect a car-house at a cost of $20,000, an engine-house to cost $35,000, and a repair shop to cost $11,000, at the corner of Thirty-first street and Kedzie avenue.

CHILLICOTHE, O.—Judge Douglas has confirmed the sale of the street railroad here. The road was purchased by Judge Warren P. Noble, Jos. Meyers and Alexander Kiskadden, administrator of Perry M. Adams, of Tiffin, O. They intend to rebuild the road, change it into a first-class electric street railway lighting and power plant, and put it on a good business foundation.

BATTLE CREEK, MICH.—The street railway company has passed into new hands and will be rebuilt at once. Mr. E. E. Dowus, for several years with he General Electric Company, but for the past two years manager of the Kalamazoo Street Railway Company, has resigned his position in Kalamazoo and will commence work there at once to get the road in operation by January 1.

ORANGE, N. J.—At a meeting of the citizens of Springfield it was unanimously voted to favor a franchise to the North New Jersey Traction Company to build and operate an electric line from the terminus of the Consolidated Traction Company's Irvington line, through South Orange, to Morrison Road. The Consolidated Traction Company is said practically to control the North New Jersey Traction Company; in fact, its counsel, Halsey M. Barrett, admitted that its officers were about the same as the Consolidated Company.

BENNINGTON, VT.—A citizens' meeting was held at Bennington to see about the advisability of obtaining a special charter from the Legislature to build an electric railroad from Bennington to the New York State line, connecting with the Hoosick railway, and a committee, consisting of E. E. Larrabee, A. P. Childs, Major A. B. Valentine, N. M. Puffor and E. L. Sibley, was appointed to look over the proposed route and report at an adjourned meeting. Major Valentine reported in behalf of the committee. Jos. A. Powers, of Lansingburgh, is one of the owners of the Burlington electric railway.

Miscellaneous Notes

IT WAS OF DR. OLIVER WENDELL HOLMES, who died on Sunday, that James Russell Lowell wrote:

"There's Holmes, who is matchless among you for wit,
A Leyden jar, always full charged, from which flit
The electrical tingles of hit after hit."

THE ELECTRICAL CLUB OF CLEVELAND, O., on October 3, elected the following officers: President, Chas. W. Mason; first vice-president, B. M. Barr; second vice-president, T. E. Adams; secretary, H. J. Davies; treasurer, E. W. Moore; Board of Managers, Chas. W. Mason, H. J. Davies, R. M. Fuller, E. W. Moore, Geo. W. Cleveland.

MR. A. N. MANSFIELD, S. B. of the Massachusetts Institute of Technology, now in the engineer's department of the American Telephone and Telegraph Co., will be the instructor of the Electricity Class at the Young Men's Institute of the Young Men's Christian Association, 222 Bowery, New York. Mr. Mansfield will endeavor to make the course of lectures meet the needs of young men engaged in various branches of electrical work. The class begins Oct. 2d and continues until May, 1895.

Trade and Industrial Notes.

W. D. HOFFMAN, agent of the Buckeye Engine Company, has removed to Room 92, Hathaway Building, 620 Atlantic Avenue, Boston.

THE QUAST GAS AND GASOLINE ENGINE COMPANY, Bucyrus, O., is in the market for good batteries and would be pleased to receive catalogues from manufacturers.

J. W. PARKER & CO., Philadelphia representatives of the Ball Engine Company, Erie, Pa., are installing one of their engines in the George W. Childs School Building, Philadelphia.

J. JONES & SON, 67 Cortland street, New York, are much pleased with the business outlook. They report a larger number of orders during September than during any month since they have been in business.

F. S. TERRY, 320 Dearborn street, Chicago, Ill., has been named assignee of the firm of Taylor, Dee & Mack, and gives notice that all persons having claims against the said firm must present such claims, under oath or affirmation, within three months from October 1.

MR. H. K. GILMAN was obliged to resign his position of business manager of the Great Western Manufacturing Company, Chicago, on September 1, owing to ill health. He intends to take a trip abroad for several months, and upon his return will resume his former duties if his health will then permit.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, has just arranged

to take the product of a well-known glass factory for insulators, and they will therefore be able to furnish the market with standard grades of insulators at factory prices. A large stock will always be kept on hand and immediate shipments can be made.

ROBT. W. SHOPPEL, 108 Fulton street, New York, is sanguine of the prospects of the Kings, Queens and Suffolk County bicycle road. Long Island was selected as the best field for the first bicycle road, and one that will immediately return the largest earnings, and he says that it is no exaggeration to expect that dividends paid by the K., Q. S. & Co. will be, at least, double the 8 per cent. guaranteeed.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has arranged to represent the Heisler series lamp exclusively in the West and carry a large and complete stock in Chicago. The Heisler series incandescent lamp is too old and well known an article to require any comments at our hands, and the Electric Appliance Company have undoubtedly added another good specialty to their celebrated line.

THE JEFFREY MANUFACTURING COMPANY, Columbus, O., is sending to its friends and patrons a handsome photogravure hanger, showing the different styles of coal mining machines built by it and arranged in the order of development, the improved chain coal cutter being the latest. The design is artistic and the different views illustrate in themselves almost the entire art of coal mining by machinery.

THE NORWICH INSULATED WIRE COMPANY, New York, has closed a contract with the West End Street Railway Company, Boston, to equip its road with underground wire, a recent order of the City Council requiring the West End Co., to bury its wires. Over 300 miles of Norwich "paper insulation" cables will be buried, 30 miles of which will be laid by the end of the year. The Norwich Insulated Wire Company has also closed a similar contract of large proportions with the Chicago Street Railway Company.

THE AMERICAN FUEL ECONOMIZER AND ENGINEERING COMPANY, 136 Liberty street, New York, in a handsomely printed and bound 38-page catalogue, gives an account of its apparatus for heating, and purifying feed water for steam boilers by utilizing the heat in flue gases. The illustrations are excellent and enable the principles of the Economizer to be easily understood. The final pages of the book contains useful data for steam users and engineers, including a table showing percentage of saving by heating feed water, properties of saturated steam, etc.

THE SIEMENS & HALSKE COMPANY of America, Monadnock Block, Chicago, has issued two large page catalogues, one descriptive of internal pole, and the other bipolar, dynamos and motors. Each pamphlet opens with a description of the type to which it is devoted, which is followed by a summary of the advantages. A lengthy list of plants installed also is given with many illustrations of machines. The various line and half tone cuts enable a very thorough idea to be obtained of the excellent machinery designed by this company whose career in America promises to rival that of the great parent company in Europe.

NORBERT B. KATES, 58 W. Eighth street, Cincinnati, O., intends shortly to establish in New York a general export agency under the name of the American Manufacturers' Export Association. Mr. Kates has just returned from an extensive trip through South America, and reports a promising opening for American goods if they are pushed with a full knowledge of the principles and customs of the trade. Among the companies which Mr. Kates has successfully represented are the Lodge & Davis Machine Tool Company, the J. A. Fay & Egan Company, the Lane & Bodley Company, the Harkness & Cowing Company, of Cincinnati, the Niles Tool Company, the Long-Alstatter Com. of Hamilton, O., the Buckeye Iron & Brass Works, of Dayton, the H. Wm. Dopp & Son, of Buffalo, N. Y., the S. A. Woods Company, of Boston, and others.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., reports the following recent sales in its Isolated Lighting Department: North Packing & Provision Co., Somerville, Mass., 1,000-lt. dynamo (3rd order); Hermann Aukam & Co., Lebanon, Pa., 600-lt. dynamo; Church Green Electric Light & Power Co., Boston, 600-lt. dynamo (9th order); Iowa School for the Deat, Council Bluffs, Iowa, 600-lt. dynamo; Connecticut River Paper Co., Holyoke, Mass., 700-lt. dynamo, 2 15-hp Manchester motors; Henry R. Worthington, Hydraulic Works, Brooklyn, one 600-lt. dynamo, one 10-hp motor, and one 45-hp. 220-volt generator; J. B. Williams Co., Glastonbury, Conn., 150-lt. dynamo; Graif Bros., Lake Crystal, Minn., 150-lt. dynamo; Ohio State University, Columbus, Ohio, 15-hp Manchester motor; Grenada Hotel, Chicago, Ill., 450-lt. dynamo; Barney & Smith Mfg. Co., Dayton, Ohio, 3-hp Manchester motor; B. T. Sturtevant Co., Chicago, Ill., 10-hp Manchester motor; G. M. Angier and Co., Boston, Mass., 100-lt. dynamo; Candee Company, New Haven, Conn., 50-lt dynamo; Morehouse Bros. Chanterico, 50-lt. dynamo; Odd Fellows Hall, Philadelphia, Pa., 50-kw direct connected, 50-kw direct connected, 80-kw direct connected, and 50-hp. in motors; S. N. Blake, Elmira, N. Y., 350-lt. dynamo; Nardi Strang Co., Philadelphia, Pa., 50-lt. dynamo; George W. Furbeck, Chicago, Ill., 250-lt. dynamo; C. B. Boothe, Los Angeles, Cal., two 5-hp Manchester motors and one 3-hp Manchester motor; Badger Lumber Co. Kansas City, Mo., 100-lt. dynamo; Leafe Bros., Winchester, Va., 50-lt. dynamo; Stanley Laboratory Co., Pittsfield, Mass., 10-kw. exciter; Diamond Machine Company, Providence, R. I., 300-lt. dynamo; West Virginia, Improvement Co., Pocahontas, W. Va., 60-kw 220-volt generator.

Business Notices

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs doing business at Rochester, N. Y. has been mutually dissolved.

All further orders for the Universal Switch Hook or Bradley-Combs switch Hook must be addressed to me as I am the sole inventor and owner thereof. Edgar S. Combs, 41 Stone street, Rochester N. Y.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

THE SOUTHERN RAILWAY, Piedmont Air Line, announces that arrangements have been perfected for movement of members and friends of the American Street Railway Association from the East and New England States upon one of the most elegantly equipped Pullman vestibuled trains, composed of dining and sleeping cars, leaving New York Monday, October 15, 1894. The route is via the Pennsylvania Railroad and Southern Railway ("Piedmont Air Line"). Leave New York, Pennsylvania Railroad, 4.30 p.m.; leave Philadelphia, Pennsylvania Railroad, 6.55 p. m.; leave Baltimore, Pennsylvania Railroad, 9.20 p. m.; leave Washington, Southern Railway, 10.43 p. m. Arrive Danville, Southern Railway, 5.30 a. m.; arrive Charlotte, Southern Railway, 9.25 a. m.; arrive Atlanta, Southern Railway, 3.55 p. m. Time, 23½ hours.

THE SOUTHERN RAILWAY owns and operates the entire line ("Piedmont Air Line") Washington, D. C., to Atlanta; also the route through "The Land of the Sky" from Washington, D. C., via Lynchburg, Va., Danville, Va., Salisbury, N. C., Asheville, N. C., Knoxville and Chattanooga, Tenn., to Atlanta, and are prepared to handle passengers with absolute comfort and despatch by either route. The route of travel is through the fertile territory known as the Piedmont regions, and presents one of the most beautiful combinations of varied and attractive scenery.

For the occasion of the meeting of the American Street Railway Association, the following rate has been made: One full fare going, and, upon presentation of certificate, one-third fare returning. If you are going to Atlanta to attend the Street Railway Convention, remember the Southern Railway, in connection with the Pennsylvania Railroad, operates a solid Pullman vestibule limited, leaving New York daily at 4.30 p. m., arriving in Atlanta next day at 3.55 p. m., with dining car service. Returning, leaves Atlanta at 1.00 p. m., arrives New York following afternoon at 1.23. The only train having a through Pullman service between New York and Atlanta. Those who desire to take the trip should arrange in advance for sleeping car accommodations (no coaches) by advising early as possible; already a large number have secured space. Five sleepers are already booked from New York, which, on arrival in Washington via Pennsylvania Railroad, will be attached to the through train on the Southern Railway for Atlanta. Representatives of Lewis & Fowler, H. W. Johns, the Okonite Company, the Walker Manufacturing Company, and E. P. Hatch, of the Boston Street Railway Company; J. H. Cunningham, president of the Massachusetts Street Railway Association; the Boston Electric Club, and other prominent people have already secured transportation or engaged passage. The special train will be under the personal supervision of Mr. A. S. Thweatt, Eastern Passenger Agent of the road in New York. This line is 14 hours quicker than that via N. & W. R. R.

Call on or address: R. D. Carpenter, General Agent; Alex. S. Thweatt, Eastern Passenger Agent, 271 Broadway, New York. Waldo A. Pearce, New England Agent; Geo. C. Daniels, Traveling Passenger Agent, 228 Washington street, Boston, Mass. F. B. Price, Agent, 32 South Third street, Philadelphia, Pa. L. S. Brown, General Agent, Passenger Department, Washington.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 2, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

Reissue 11,442. SECONDARY ELECTRIC BATTERY; C. Theryc and Oblasser, Paris, France. Application filed July 4, 1893. This consists of a conductor, active material surrounding the same, and a perforated envelope of cellulose free from foreign substances, and having its parts united by cement having a celluloid as a base, the active material and conductor being inclosed on all sides by the envelope.

526,686. ELECTRIC MOTOR; J. H. Clark, Boston, Mass. Application filed April 16, 1894. A motor having a casting for the frame formed with a back having a hub on each side of the back and L shaped projections forming the poles of the field magnet. (See illustration.)

526,704. TROLLEY WIRE HANGER; J. J. Green, Boonton, N. J. Application filed June 4, 1894. This comprises supporting devices consisting of parts struck from sheet metal and formed so as to be adapted to conjointly engage the trolley wire supports.

526,705. TROLLEY SPRING; J. L. Hanson, U. S. Army. Application filed May 14, 1892. A spring comprised of two clasp springs having their spiral bends interlocked, and the ends of their members oppositely connected.

526,720. ELECTRIC WINDING AND SETTING CLOCK; H. Loriot, New York, N. Y. Application filed Oct. 3, 1893. This comprises a magnet, a synchronizing wheel, a pivoted armature lever, pivoted levers and means for restoring the several levers to their initial positions.

526,721. COMPOSITION OF MATTER FOR ELECTRIC CONDUCTORS; D. McFarland, Philadelphia, Pa. Application filed May 16, 1894. A compound composed of asbestos or mineral wool, graphite and a binder.

526,722. COMPOSITION OF MATTER FOR ELECTRIC CONDUCTORS. D. McFarland, Philadelphia, Pa. Application filed May 19, 1894. A baked compound structure composed of graphite, clay, asphalt or coal tar, chloride of aluminum and a binder.

526,723. ELECTRIC IGNITING APPARATUS FOR FIRE ENGINES; W. C. Matthias and W. Hartman, Reading, Pa. Application filed Oct. 2, 1893. The combination with a gas burner and the electric igniting attachment thereto, a gas cock and stop, a vibrating arm and connected spring, an operating lever having a limited independent movement and a separate spring to hold the lever in operative position.

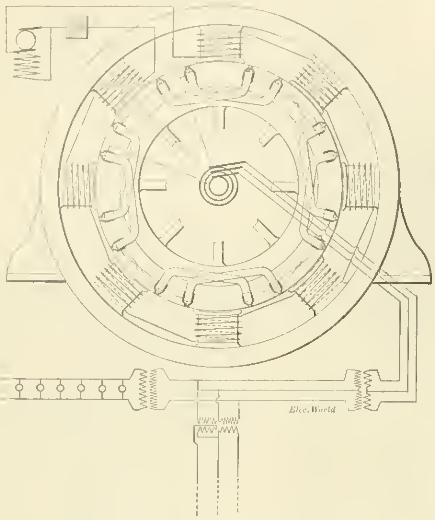
526,725. ELECTRIC SNAP SWITCH; A. Metzger, Schnectady, N. Y. Application filed May 11, 1894. This comprises a ratchet plug, ratchet faces at one end thereof, and a central longitudinal passageway for the handle shaft, with a recess at one end of the passageway and in the end of the plug surrounding the passageway.

526,736. LIGHTNING ARRESTER; F. S. Pearson, Boston, Mass. Application filed Sept. 7, 1891. This comprises a lightning arrester, a switch, its

detent, an electro-magnet, a fuse, a main circuit and a branch circuit with two branches, one branch containing the arrester, and the electro-magnet in series, and the other the fuse.

526,742. COMMUTATOR; H. G. Reist, Schnectady, N. Y. Application filed June 28, 1894. This comprises a supporting spider with the interior bevelled faces, a clamping ring and a bevelled nut adapted to fit the space between the clamping ring and the inner bevelled face of the spider, in combination with a commutator segment adapted to fit the opposite surface of the clamping ring.

526,743. DYNAMO ELECTRIC MACHINE; E. W. Rice, Jr. Application filed February 28, 1894. This comprises an armature having coils in series, con-



No. 526,743.—DYNAMO-ELECTRIC MACHINE.

nections to external circuits from the ends and an intermediate portion of the coil, and field magnetic poles embracing an arc less than the greatest angular displacement between the coils. (See illustration.)

526,756. TROLLEY GUARD; H. J. Tanner, Lynn, Mass. Application filed April 2, 1894. The combination with a trolley wheel and yoke, of balls or wheels which meet above the trolley wire and are separated by the pressure of the trolley wire upon them when the wire enters and when it leaves the space inclosed by the retaining devices and the wheel.

526,760. ELECTRIC ALARM OPERATING MECHANISM; P. C. Thompson, Elmira, N. Y. Application filed Dec. 19, 1893. The combination with a frame adapted to be placed in communication with an electric bell, of a track pivoted thereto, contact pieces on the frame and track, a ball weight movable on the track, mechanism independent of the track for driving a ball, and means for actuating the ball driving mechanism.

526,767. ELECTRIC RAILWAY CONDUIT; R. B. Wilson, Cincinnati, O. Application filed Jan. 2, 1894. The combination with a conduit, notched in the upper edge of its wall, of a bracket and a hanger-block.

526,810. APPARATUS FOR PUTTING ELECTRIC MOTORS INTO CIRCUIT; C. Hoffmann, Charlottenburg, Germany. Application filed Oct. 29, 1892. This consists in automatically and simultaneously varying the resistance of the circuit in inverse proportion to the counter electro-motive force of the motor.

526,825. ELECTRIC LAMP HANGER; W. S. Weston Chicago, Ill. Application, filed Jan. 13, 1894. The combination of a revolving lamp supporting drum and supporting cables, a frame upon which the drum is mounted, a circular ratchet attached to the frame, a revolving spring actuated pawl adapted to engage the ratchet, and means for operating and holding the pawl free from the ratchet.

526,833. ELECTRIC BELT; J. J. Hankey, Beaver Dam, Wis. Application filed July 18, 1894. This comprises a flexible waterproof casing, a pair of flexible batteries within the casing, an electrode detachably connected to the inner terminals of both batteries, and two electrodes, each of which is connected to an outer terminal of a battery.

526,835. CONDUIT RAILWAY TROLLEY; R. J. Hewett St. Louis, Mo. Application filed Feb. 9, 1894. A conduit collector provided with an adjustable steering device engaging the slot walls at a point in advance of the plow to automatically adjust the collector to curves.

526,850. CONDUCTOR SWITCH, G. H. Benjamin, New York N. Y. Application filed September 28, 1893. This comprises a main track and adjoining switch track, working conductors for each of said tracks, one of the tracks having a sectional conductor normally out of the plane of the conductor of the other track, but adapted to be brought into line with the adjacent sections of the conductor of its own track and close the gap there between

526,865. TELEPHONE; H. W. Libbey, Boston, Mass Application filed Aug. 1, 1892. In a telephone, an armature arranged between the poles of a horse shoe magnet, and the diaphragm, the armature being suspended by cat gut or silk cord.

526,867. RHEOSTAT, D. McFarland, Philadelphia, Pa. Application filed May 18, 1894. This comprises a homogeneous baked composition structure for controlling or adjusting voltage of an electric circuit and provided with pin contacts, conductors from a source of energy in connection with said structure, and a switch adapted to be manipulated in the path of the contacts.

526,879. DYNAMO REGULATOR; J. Van Vleck, New York, N. Y. Application filed May 31, 1894. A series of dynamo regulators, each having a support of segmental shape, the supports having their curved peripheries side by side, a series of contact strips on each support periphery, an arm provided to each support and carrying a contact plate over each series of contact strips, and a series of resistances connected with each series of contact strips.

526,888. TRANSMITTER FOR TELEPHONES; M. O. Anthony, Cincinnati, O. Application filed July 28, 1894. This comprises a supporting plate, a series of carbon blocks projecting therefrom, a series of carbon pencils extending from block to block, and a transverse pencil or pencils connecting one or more pairs of pencils in series and locking them against rotation.

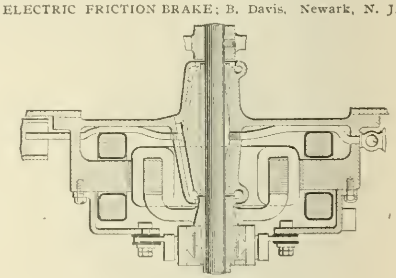
526,893. FIRE ALARM TELEGRAPH SYSTEM; W. E. Decrow, Boston, Mass. Application filed March 13, 1893. This comprises central and local stations, a circuit connecting them, a series of circuits extending from the local station, and a switch placed at a point outside the local station for disconnecting the lines therefrom, and connecting them in series with the central station.

526,897. ELECTRIC RAILWAY TROLLEY; R. A. Grant, Providence, R. I. Application filed January, 22, 1894. This comprises an end piece, pivot shaft, side frames, trolley wheel, spring, ratchet wheel, and pawl.

526,909. ELECTRIC LOCK, T. P. Pratt, Boston, Mass. Application filed May 7, 1894. This comprises a lock, a keeper for the bolt, and an electro-magnet and circuit therefor, the arrangement being such that when the circuit is broken the keeper is rigidly locked, and when the circuit is closed the keeper is released so that the bolt can pass out.

526,963. CONDUIT FOR ELECTRIC RAILWAYS; M. Cattori, Rome, Italy. Application filed April 3, 1894. This comprises a tubular conduit, a support located therein, and secured by its ends to the sides of the conduit, and a fish plate formed on to the chair to fasten the track rail in position on the conduit.

526,966. ELECTRIC FRICTION BRAKE; B. Davis, Newark, N. J. Applica-



No. 526,686.—ELECTRIC MOTOR.

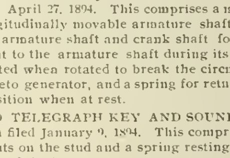
tion filed March 28, 1894. This comprises a drum mounted fast upon the axle, the same consisting of a metal hub and radial arms, and a peripheral portion formed of separate sections attached to the arms and insulated from each other, bobbins placed on the arms, a magnetizable strap surrounding the drum, and an electric circuit extending through the bobbins.

526,982. MAGNETO CALL BELL; J. B. Smith, Manchester, New Hampshire. Application filed April 27, 1894. This comprises a magneto machine having a rotary and longitudinally movable armature shaft, a crank shaft, gearing intermediate the armature shaft and crank shaft for imparting the longitudinal movement to the armature shaft during its rotation, the armature shaft being adapted when rotated to break the circuit and cut in the armature of the magneto generator, and a spring for returning the armature shaft to its normal position when at rest.

526,985. COMBINED TELEGRAPH KEY AND SOUNDER; P. D. Cox, Jasper, Fla. Application filed January 9, 1894. This comprises a base and key, a threaded stud, nuts on the stud and a spring resting on the nut and pressing the under surface of the key.

526,992. COMBINED SYSTEM OF ALTERNATING AND DIRECT CURRENT DISTRIBUTION; A. L. Clough, Manchester, N. H. Application filed May 15, 1894. This comprises distributing conductors, branches connecting translating devices to direct current mains, transformers having their primaries connected to alternate current mains, and devices to short circuit the direct current mains when the alternate current is on, and to remove the short circuit when the alternating current is off.

527,037. ELECTRIC MOUTH BATTERY; L. Funk, Chicago, Ill. Application filed November 27, 1893. This comprises metal plates of opposite polar-



No. 527,037.—ELECTRIC MOUTH BATTERY.

ity so disposed as to be exposed to excitation by the saliva in the mouth, and conductors not exposed to excitation by the saliva connecting the several plates. (See illustration.)

527,034. SCALE AND INDEX FOR ELECTRICAL MEASURING INSTRUMENTS E. Weston, Newark, N. J. Application filed March 15, 1894. This comprises a scale plate of salient cross-section, a movable index and transverse arm on the index extending over the scale plate.

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CONTENTS.

ACCIDENTS TO FLY WHEELS.

The discussion we print in this issue on the cause of accidents to fly wheels in power stations furnishes the most important contribution to the general subject of fly wheel accidents that has, we believe, even appeared in a technical journal. All of the engineers who take part are well qualified to write on the subject. One is recognized, not only in this country but in Europe, as the leading authority on the design of fly wheels, while at least one other is a similarly recognized authority on the theory of engine design and the properties of engineering materials. As will be seen, the concensus of opinion is that, while a sudden load thrown on a generator is not without danger, yet destructive strains are rather to be ascribed to centrifugal than to tangential stress; there is also substantial agreement that defectively designed or inoperative governors are the usual active causes of accidents. The most important conclusions to be drawn from the discussion are that cast-iron fly wheels are engineering absurdities, and that the engine governor is probably the most important piece of apparatus in a power house and should receive corresponding attention.

REACTANCE.

Last week we called attention to a criticism by Prof. Blondel of Paris, on the definition reactance as given in Messrs. Steinmetz & Bedell's paper, published in our issue of June 30th. The electrical system of units and terms is the most perfect and the most international of all those in other branches of science and engineering, and it is therefore of great importance to keep it at the head of the list by having perfect agreement on all points pertaining to the system. In order to give all an opportunity to discuss this subject of reactance, we give in this issue a complete translation of Prof. Blondel's article, accompanied by a very able discussion by Messrs. Houston and Kennelly on the points raised. We hope the subject may be thoroughly ventilated and that the discussion will bring about a uniform use of this important term in this country and abroad. In reply to Prof. Blondel's remark that due credit had not been given the Société Internationale des Electriciens for having originally suggested this word, we desire to call attention to the fact that in the article on this term in our issue of May 26, page 712, we, at least, acknowledged that the term originated with that society.

AN ELECTRIC STREET RAILWAY NUMBER.

As a recognition of the importance of the meeting in convention of the American Street Railway Association at Atlanta during the present week, The Electrical World devotes the greater part of this issue to subjects relating to electric traction. Believing that the professional benefit of those connected with the electric street railway industry can be better served on this occasion than by printing a general tourist's guide to the convention city and surrounding country, or perfunctory articles with no technical value, we present instead a budget of matter whose value is not of such a transient character. The article on the Atlanta street railways furnishes in concise form the most exhaustive account of the important points relating to this extensive system that has as yet been published. The articles by Prof. Hermann S. Hering on the vast system of the Philadelphia Traction Company, will describe in detail the various engineering features of what constitutes the finest example of modern electric railway engineering in this country, which is equivalent to saying, in the world. Lieut. Cahoon and Mr. George T. Hanchett ably deal with the no less important points of operation and management, and the discussion on fly wheel accidents in power stations furnishes the most valuable contribution to the subject ever made.

STANDING LOADS ON RAILWAYS.

In a discussion in London on the Liverpool electric railway, a Mr. O. F. Nichols stated that "American lines encouraged standing loads" on railways. We suggest that the word "lines" should have been underscored, as it is the companies and not the people who "encourage" it. On some German railways there is a fourth-class, in which ordinary cattle cars are used with nothing but a few posts to hold on to; the chief difference between this system and ours, however, is that there, respectable people are not compelled to ride in that way, but they may do so if they prefer, the price being only half as much as the second-class fare. When high speed, such as is proposed by some enthusiasts, is introduced, then standing loads, or better, hanging loads, will naturally be "encouraged" by the people, and there will then be a real advantage in standing or holding on to the straps, as those who are fortunate enough to get hold of a strap will then swing freely like a pendulum, while those unfortunate enough to get a seat will, owing to the laws of centrifugal force, be tossed about like a foot ball in the old style game, in which it was the ball and not the players that was kicked about. When that time comes, the German lines may charge an increased fare for the privilege of standing up.

LIGHT FROM CITY REFUSE.

We are pleased to see that the much talked of scheme for utilizing the energy residing in a city's refuse and converting it into electric light, is about to be put into practical operation in the historical little town of Ealing, in England, where Huxley was born, where Thackeray, Edward Bulwer Lytton and other famous writers went to school and where Dickens often visited. Suggestions on paper are cheap, as they cost merely the paper and the ink, and it is therefore not surprising that much has been written on this fascinating subject, but what is really wanted to further the introduction of such apparently reasonable methods, is an actual test, from the records of which reliable data can be obtained. The results of this not unwarranted municipal enterprise will be waited with great interest. It appears that the oragnic refuse of this town is now being destroyed by fire, generating steam which is used for pumping works,and it therefore only requires an extension of the present system to utilize the steam also for generating electric light. One of the difficulties in utilizing refuse will, it seems, be oevrcome by mixing some coal with the refuse. Another important feature is that the refuse must be burnt at a high heat in order that it may not give off offensive odors and to accomplish this there should be complete combustion in the boiler before heat is abstracted from the gas. The town is not large, having a population of only 27,000 and only a portion of it will be supplied, with 5,000 lamps of 8 candle-power. The experiment, although not on a large scale, is still sufficiently so to give results on which similar installations can be based. We do not doubt that it will be a success, as the refuse must be destroyed in some way; the only question is whether the economy will be sufficient to warrant the cost, or if it is cheaper to do each separately.

ILLUMINATION.

In the science of photometry there is only one unit at present in use, the candle-power, and with this much-abused, ill-defined, unsatisfactory unit, writers on photometric subjects have tried to express no less than five different quantities. This branch of physics, so important to electrical engineers, is therefore sorely in need of attention and it is important that the electrical engineers and physicists take up the subject before photographers introduce special units and terms which would not be the best for the whole subject in general. A very good beginning at systematizing photometric units was recently made by Prof. Blondel, as was shown in the Digest in the issue of August 11. While this is an excellent beginning, his system is not quite perfect and we call attention to it again in order that it may be fully discussed before the terms he proposes have become too well established. One point which we think will be a very serious drawback to the adoption of his system, by English speaking countries at least, is that he uses the French word "illumination" for a totally different quantity than that for which the English term illumination is used. The new French term is the product of what is known in English as illumination by the factor time, and corresponds to what photograph's call "exposure." It seems to us very important that one of these terms should be changed or else there will be a continual confusion between them. As the English term is already too deeply rooted in the science to be changed now, and as the French term is new, it is not unreasonable to ask the French to change their term, which, by the way, is also badly chosen for other reasons. To call it "exposure" would not be advisable, as that term is special to photography and has no meaning outside of that field. As there is no objection to using several words, we suggest the term "duration of illumination," as that explains itself, it being the product of the duration or time and an illumination. "Quantity of illumination" corresponding in its derivation with that of another term "quantity of light" (candle-power multiplied by time), is another name that might be used, but we think that the term "duration," which itself implies the "time" element, is preferable to "quantity," which does not necessarily carry with it the idea of time. For the same reason we recommend changing Prof. Blondel's last term "quantity of light," that is, the candle-power of a light multiplied by the time during which it lasts, into "duration of light," or still better and in accordance with the suggestion of Mr. Hospitalier, simply "lighting." It is this unit by which light would be measured in commerce if it is paid for, as it should be, according to the candle-power and the number of hours during which the lamp burns.

ELECTRIC RAILROADS.

Some good papers on the Liverpool elevated electric railway, were recently read and discussed, abstracts of which appeared in these columns. The conclusion to which every unbiassed person must now come, after giving the matter due thought, is that this, the first permanent elevated railway operated entirely by electricity, is a perfect success; not that it could not have been better, but that as it stands it is a success. This pioneer line ought to convince those who, although recognizing surface electric traction as a success, still had doubts about the application of electricity to an elevated line. Arguments to show why electric traction should be better than steam are no longer required, as they have frequently been given, but what remained was to really show by an actual case that the arguments were correct. One of the most striking proofs, at least to the capitalist, is that the original contract for the Liverpool line required the contractors to operate the road at a certain fixed price per train mile for a certain time, which price was evidently considered a fair one; but after running awhile the company found that the contractors were making too much money and it decided to relieve them of this obligation long before the stated term had expired. What better proofs could a capitalist want? And this on a pioneer elevated road. Among other things which are noticed in our columns aud which show that decided progress is being made in the direction of heavier electric traction, are that a French railroad company is at present building 60 locomotives for driving 800 tons at 15 miles an hour. Also that chief engineer Parsons, after making an exhaustive study ot European city railways, reported to the Rapid Transit Commission of New York, that steam would be intolerable in an underground railway, and that with a speedy, frequent service an underground road can be operated successfully and economically by electricity. It is now quite safe to predict that no more elevated or underground city railways will be built to run by steam locomotives. An underground electric road is now being built in Budapest, an overhead line in Berlin, while Vienna and Paris are both consideirng the construction of underground electric roads, and in London the extension of the existing underground electric line, the pioneer of its kind, to run east and west through London, is likely. In connection with surface lines we give a brief description of a surface sectional conductor system, which has been running successfully for some months in Lyons, although we believe that this particular system is too complicated for general introducion.

Concerning Reactance.*

BY ANDRÉ BLONDEL.

The fact is known, although attempts have recently been made to ignore it, that the term "reactance" was first officially proposed by the Societe Internationale des Electricians, at its session of June 6, 1893, in conformity with the report of the committee it appointed to examine the proposals for the Chicago Congress. This convenient term, which has since been adopted by this journal, was advantageous in terminating the confusion introduced by the ambiguous use of the term "inductance," and also, for the first time, enabled the analogous but opposing effects produced in a circuit by self-induction and capacity to be united under a single name.

It was not surprising, therefore, that the term rapidly found favor abroad, and that it was recently adopted by the American Institute of Electrical Engineers, which is always distinguished for its progressive tendencies. There is reason to fear, however, that the acceptation now given to the word "reactance" across the Atlantic, extends somewhat beyond that which its originators desired to give it, and I believe that it is desirable to point out the intended misapplication, in order to place French electricians on their guard against the errors that may result in consequence.

In defining reactance, the French committee proposed to give a name to the effect of the virtual resistance produced by self-induction, or by capacity, or by both combined, in an alternating current circuit.

If E be the effective E. M. F., I the effective current strength produced, and R the ohmic resistance, the current can always be expressed in the form

$$I = \frac{E}{\sqrt{R^2 + K^2}},$$

the denominator being what is known as impedance. The term K is called the reactance. In the particular case where the current follows a simple harmonic law

$$K = \left(\omega L - \frac{1}{\omega C}\right)$$

L being the inductance (or coefficient of self-induction), C the capacity, and $\omega = \frac{2\pi}{T}$ the pulsation of the current.

Thus defined, reactance is a constant of the circuit for a given frequency, of the same nature as its resistance (the same quantity being formerly called the inductive resistance).

In my judgment, it is precisely because it is a constant, that the reactance has a claim to independent title; for by that reason it permits the numerical definition of alternating current circuits to be completed whose ohmic resistance is insufficient to characterize them, and to predict the phenomena which will be produced under the influence of one or more definite E. M. F's.

Two American authors, who desired to generalize the definition of the Societe Internationale, have recently published a new conception of it, diametrically opposite in character, and which has unfortunately been everywhere reproduced without protest.

They state in a manner which does not appear to admit of any possbility for dissent: "Reactance is equal to the reactive E. M. F., that is, to the component of the total E. M. F., which is in quadrature with the current, divided by the strength of the current. Reactive electromotive forces are set up in alternating current circuits by self-induction, mutual induction, capacity, or by outside counter E. M. F.'s, such as those of synchronous motors;" and again, as an application to the case of a transformer. "The counter E. M. F. (produced by the secondary) can be decomposed into two others, one in phase with, and the other in quadrature with the current. The first gives a power E. M. F., the second a reactive E. M. F. The counter E. M. F. of a motor can be treated in the same way." From this point of view, reactance is no longer a constant of a circuit; it varies according to circumstances, being a complex and heterogeneous combination of all kinds of reaction, of which several do not exist save under the influence of neighboring circuits. It is therefore no more than a new name applied to phenomena better defined in other ways.

This is, I believe, an unfortunate conception, which can give rise to much misunderstanding. Thus we are informed that the component of an E. M. F. in quadrature is the product of the current and the reactance. How then about the component in phase? Everyone would suppose, after reading the paper referred to, that it is equal to the product of the current and the ohmic resistance, which is not the case. If this error is to be avoided it will be necessary to define a new quantity, which would be the quotient of the E. M. F. in phase with the current by the current strength. But an absurd complication would thus be brought about, and all the more useless, since the quantities whose names terminate in *ance* would be variable.

How much more satisfactory, on the other hand, is the conception of reactance as a constant property of a circuit. If this be isolated, the current which traverses it depends only upon the impedance and upon the applied E. M. F. If it includes a synchronous motor, it will be sufficient to take for this E. M. F. the resultant of all the active E. M. F's. This greatly simplifies the theory of alternating current motors. If a transformer be introduced, both primary and secondary circuits will have definite resistances and reactances, and the effect of the reaction of the secondary will be equivalent to an apparent modification, not only of the reactance of the primary, but also at the same time of its ohmic resistance.

It is needless to add that it will be sometimes desirable to decompose E. M. F's into two components. This is sometimes useful. In general the inverse operation is often more effective, i.e., the decomposition of the current into two components: the active current, and the inactive current (German wattstrom and wattloserstrom). In every case, however, this decomposition has no reason to be extended to the definition of reactance.

Conclusion: Reactance, like all words terminationg in *ance*, should serve to define a single constant in a circuit. It need not then apply to any but the effects of inductance and capacity in the circuit. I believe it is undesirable to adopt in France a new definition. If it be desired to represent the effects of mutual induction or of outside E. M. F's. by a quantity analogous to this constant from the standpoint of effects produced, it would be well to specify explicitly that an *apparent* "reactance" is dealt with; that is to say, a purely fictive quantity having no real existence.

*From *L'Industrie Electrique*, September 25, 1894.

On the Definition of the Term Reactance.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

We notice on p. 416, Vol. III, No. 66, of "L'Industrie Electrique" for September 25, 1894, an article by M. A. Blondel entitled "Apropos de la Reactance" and in which the author calls into question the use of the term reactance as applied in America, and contrasts this use with that suggested by its original authors in France.

Briefly, the history of this term is as follows: In No. 33 of "L'Industrie Electrique" appearing on May 10, 1893, p. 207, M. Hospitalier discusses the subject of symbols and notations for physical quantities. He suggests that the term reactance should be applied to the expression denoted by K, in the equation for harmonic currents,

$$I = \frac{E}{\sqrt{R^2 + K^2}}$$

In the June number, 1893, of the Bulletin of the Société Internationale des Electricians, in the report of the Committee appointed by the Société to formulate a discussion upon the Congress proposals of the American Institute of Electrical Engineers, the following sentence appears:

"The Committee proposes that a name should be given to the quantity whose square added to the square of the resistance in the circuit traversed by a periodic current, gives the square of its apparent resistance. The name reactance could be applied to this quantity."

At its Philadelphia meeting this year, the American Institute of Electrical Engineers adopted the term "reactance" for "the ratio" in "alternating current circuits of the quadrature component of E. M. F. to the current." (Transactions A. I. E. E., Vol. XI, No. 6, June, 1894, p. 327.)

This is a quantity whose square added to the square of the resistance in an alternating current circuit is the square of the impedance, except when mutual induction is operative.

If an alternating current circuit possessing resistance, inductance, and capacity, has an E. M. F. with any wave type,—simple harmonic, or complex,—of, say, 1,000 volts effective, and the current in the circuit is 2 amperes, then the impedance of the circuit under any conditions is 500 ohms. Further, if the circuit be electrically isolated, so that no mutual induction exists between it and other circuits, and if the resistance of the circuit, as measured by a continuous current, is 300 ohms, then the reactance of the circuit will be 400 ohms. This would be the amount of reactance under the proposed definition of the Société Internationale, or under the

definition adopted by the American Institute, and in this sense the term seems to have been applied with the same significance by Blondel and Hospitalier in France, Silvanus P. Thompson, in England, and Steinmetz and Bedell in America. When, however, mutual inductance exists, as, for example, when transformers are included in the circuit with loaded secondaries, the reactance, by definition of the Amerlican Institute, differs from that which M. Blondel desires to see adopted, and also from that proposed by the Société Internationale; for, the practical effect of loading the secondary circuits is to reduce the quadrature component of reactive E. M. F., and to bring the impressed E. M. F. and the current more closely into phase. The reactance of the circuit by the American Institute definition, therefore differs from its isolated reactance. M. Blondel considers that this is a misconception, that the reactance of the circuit should be its isolated reactance, and a constant for that circuit, like its inductance, or resistance. He intimates that such was the intention of those who first suggested the word, the ending of which, *ance*, is usually associated with fixed quantiites of matter depending on form. It is only fair to point out, however, that the degree of fixedness of reactance in a circuit, is, in any event, considerably less than that of resistance or inductance; for, neglecting temperature effects, these are constant for all commercial frequencies, while reactance varies, even in an isolated circuit, with the frequency of alternation, and with the wave type of E. M. F.

Seeing that no confusion exists between the definition of the Société Internationale, or the American Institute, or M. Blondel, upon the meaning of reactance when referring to isolated circuits, all confusion can be avoided by specifying "equivalent reactance," and "equivalent resistance" for the particular cases of mutally inductive circuits. In that event, the product of the square of the current and the equivalent resistance ($I^2 R'$) will be the rate of expending energy in a mutually inductive circuit, while the product of the square of the current and the resistance ($I^2 R$) will be the rate of expending energy in an isolated alternating or continuous current circuit.

By the use of this phraseology, not only will the objections of our French co-workers be apparently overcome, but no violence will be done to the definition adopted by the American Institute.

Laboratory of Houston and Kennelly, Philadelphia.

Alternate Current Working—VII.

BY HARRIS J. RYAN.

The following four examples are given for the purpose of making a study of the simple effects of the presence of capacity in electric circuits. In the first of these, see Fig. 23, current from a source of pressure at A is established through a condenser K in series with a non-inductive resistance R.

$$E_A = 500 \text{ volts at 125 p. p. s.},$$
$$R = 117 \text{ ohms},$$
$$K = 10 \text{ microfarads}.$$

The impedance for ohmic resistance and capacity is

$$\frac{E}{C} = \sqrt{R^2 + \frac{1}{K^2 \omega^2}}$$

$$C = \frac{500}{\sqrt{117^2 + \frac{1}{(10 \times 10^{-6} \times 2\pi \times 125)^2}}}$$

$C = 2.87$ amperes.

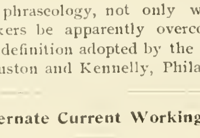


FIG. 23.

In the next example (see Fig. 24) we want to know what capacity must be used to balance the inductance of the field of a shunt motor. The applied pressure is 100 volts at 125 p. p. s., the resistance of the field is 200 ohms, number of field turns 4,250, field induction 300,000 lines. L, for a circuit that contains 4,250 turns about an induction of 300,000 lines produced by a current of .5 amperes, is determined in the following manner:

$$B = \frac{E}{1.4 \pi\, a\, t \backsim}\; B a = M$$
$$E \doteq M\, 1.4 \pi\, t \backsim = L \omega C$$
$$L = \frac{M\, 1.4 \pi\, t \backsim}{\omega C} =$$
$$L = \frac{300{,}000 \times 1.4 \pi \times 4{,}250 \times 125 \times 10^{-8}}{2 \pi\, 125 \times .5}$$
$$L \doteq 17.8 \text{ henrys.}$$
$$E_L = 17.8 \times 785 \times .5 = 7{,}000. \text{ volts}$$

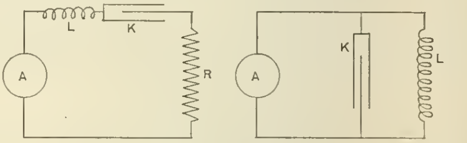
It was determined that when $L\omega = \frac{1}{K\omega}$ in any circuit, the opposing capacity and induction E. M. F.'s will balance, whence

$$K = \frac{1}{L\omega^2} = \frac{1 \times 10^6}{17.8 \times 785^2}$$
$$K = .09 \text{ microfarads.}$$

The pressure that the field current of .5 amperes will develop in passing through the condenser is determined from the relation

$$C = E K \omega \times 10^{-6}$$
$$E = \frac{.5}{.09 \times 785} = 7000. \text{ volts.}$$

Likewise the pressure developed in the field circuit by the field induction is $E = CL\omega = .5 \times 17.8 \times 785 = 7{,}000$ volts. The ca-



FIGS. 24 AND 25.

pacity and induction E. M. F.'s are equal and opposite, so that current is established through the circuit just as though they were absent so long as the insulation of the circuit and condenser is good and sufficient to stand the 7,000 volts. It will be remembered that the capacity E. M. F. is 90 degrees behind and induction E. M. F. 90 degrees ahead of the alternating current. Motors of this class for which this example applies are at present still in the experimental stage.

In the diagram of Fig. 25 the condenser is used in parallel with an apparatus that possesses inductance, such as the "hedgehog" transformer with secondary on open circuit. Current is supplied by A at a pressure of 1,000 volts at 125 p. p. s. The induction current that is established through the primary of the transformer with the secondary on open circuit has been measured and found to be one ampere. When studying the phenomena of induction and capacity it was noted that the induction and capacity current are exactly opposed to one another when they produce the same E. M. Fs. Here we want to know what capacity must be used so that the induction and capacity currents will be equal and opposite and the line current reduced to zero. The reactance E. M. F. of K is 1,000 volts.

$$E_K = \frac{C_K}{K\omega} = 1000 \text{ volts.}$$

Now the current L equals one ampere, the current through K must, therefore, be one ampere, whence

$$\frac{1}{K \times 10^{-6} \times 785} = 1{,}000.$$
$$K = 1.235 \text{ microfarads.}$$

In practice one would not in general realize exactly all the conditions that are necessary to attain an exact balance of this sort.

(To be continued).

Electricity and the Whitewashing Trade.

Painters and whitewashers will not be pleased to hear the statement of Mr. Whiteley, an Englishman, that he saves $2,500 a year in less paint and whitewash by using the electric light. The Painters' and Whitewashers' Union in this country will probably proceed at once to boycott any one who dares to use the elec-ic light; a little thought and science, however, will show them that a fresh coat of whitewash in factories and other like places will often save more than its cost in the reduction of the amount of electric light required.

ELECTRIC SYSTEM OF THE PHILADELPHIA TRACTION COMPANY

BY HERMANN S. HERING.

The Philadelphia Traction Company was the first of the street railway companies in Philadelphia to change its motive power from horses to electricity. Two years ago there was the most strenuous opposition to the introduction of the trolley system into Philadelphia, when this company applied for the privilege. Mass meetings were held, petitions were circulated, councilmen were threatened and every effort made by the people to prevent this "invasion of the deadly trolley." The Philadelphia Traction Company, however, fought long and hard and finally, by means of a loop-hole in the charter of the Catharine and Bainbridge Streets line, and through their promises to build the road in the safest and best manner possible, and pave the streets from curb to curb, succeeded in obtaining the right to equip and operate this line by electricity. It was to be a "model road" and show the people of Philadelphia what a good trolley road was, most of those who objected never having seen one. The feeders were all to be placed underground, the trolley wire protected from wires falling across it by means of guard wires, neat iron poles were to be used, the street paved with asphalt from curb to curb, the cars stopped at every street crossing and on the near side, to avoid accidents, and every precaution taken to further the successful operation of the road.

The experiment was a thorough success and broke the ice of opposition, and since then permission has been granted to this company for the electrical equipment of all of its lines, and to the other street car companies as well, and within two years, between 100 and 200 miles of trolley roads have been laid and operated in Philadelphia, or about to be started, and most of this has been done within the past year. A contrast to the strong opposition of the people two years ago, was shown during the opening of a road with this new equipment recently.* The first cars were greeted by the shouts of hundreds of people, who lined the route and gave vent to their enthusisam with fireworks and brass bands; banners were displayed with such phrases as "Welcome Rapid Transit," etc., and the officials who occupied the first car were showered with flowers by the ladies along the road.

All of the car lines which have been equipped for electric traction have been obliged to follow the general plan of the first and so called "model road," embodying underground feeders, iron poles, guard wires, and a new pavement from curb to curb of either asphalt or belgian block, according to the requirements of the Department of Public Works of the City Government. Thus Philadelphia is being equipped with trolley roads of the safest and best character, and is also enjoying the benefits of newly paved streets, a great contrast to the historic cobble stones. This was undoubtedly due, to a large extent, to the determined opposition which the railway companies had to overcome, as experience in other cities shows that the street car companies do not pave the streets and put the feeders underground of their own volition. Most of the franchises are very valuable, however, and the city is entitled to some return therefrom. By putting in a first-class equipment at the outset the companies will be the gainers in the end, as the operation is thus more satisfactory and more economical and the item of repairs small.

The rapidity and thoroughness with which the roads of the Philadelphia Traction Company have been equipped and the stations constructed, and the success with which they have been operated from the start, reflect great credit upon the management of the company, but especially upon the skill and perseverance of the enigneering staff, to whose ability and conscientious efforts this success is mainly due.

The officers of the Company are as follows: President, P. A. B. Widener; first Vice-President, W. L. Elkins; second Vice-President, G. D. Widener; Secretary and Treasurer, D. W. Dickson; General Manager, J. T. Gorman; Electric Engineer, F. Uhlenhaut; Jr., and they are well known as among the most progressive railway men in the country.

GENERAL.

The Philadelphia Traction Company operates at present about 119 miles of equivalent single track road, electrically, 34 miles by means of cables, and 25 miles by horses, making a total of 178 miles. It contemplates equipping all of its present lines with electricity and building new lines into the suburbs as soon as possible, reaching a total mileage eventually of about 300.

The complete cost per mile, not including the power stations, has been about $30,000 and this company has spent several millions already in the electrical equipment and will spend a million or two more.

The map in Fig. 1 shows the electric roads of the company in operation and in *immediate* contemplation, representing about 116 miles of single track and 37 miles of double track or a total of 190 miles of equivalent single track, which is 12 miles more than the total mileage they operate at present. The system extends from the eastern to the western limits and from the northern to the southern portion, and reaches nearly all of the important parts of the city and, with one exception, is the most extensive electric system operated by one company in the world, and is the first large system to use underground feeders.

The power is generated in four stations, as shown on the map. Station A, at Sutherland avenue and Kansas streets feeding the southern portion of the city, which was the first one started; station B, at 13th and Mt. Vernon Streets feeding the central portion, and the second one started; station C, at 33rd and Market Streets, feeding West Philadelphia, and station D, 32nd and Dauphin Streets, which is nearing completion and is to feed the lines in the northern part of the city. These stations aggregate at present about 11,550-hp and have an ultimate capacity of 19,800-hp.

Table I. contains the principal dimensions of these stations and the approximate number of cars operated by them at present, though this number will be increased considerably in a short time.

Table II. contains a list of the various roads in operation with their lengths, number of cars operated on each, and other data—23.79 miles of single track and 15.66 miles of double track will be operated electricaly in a month or two, comprising one of the old cable lines, and some of the horse car lines in West Philadelphia and in the northern section.

THE POWER STATIONS.

23d and Sutherland Ave.—Station A.

This was the first of the various stations being built for the Catharine and Bainbridge Streets line, the "model" road, and as there was some doubt about how the experiment with trolleys in Philadelphia would turn out, this station was not built on an extensive plan, but was so arranged that an annex could readily be constructed. The building of this annex is nearly completed and some of the new machinery will soon be running. Fig. 2 shows a view of the exterior of this station; the one in the foreground is the original building, and the one at the back, the addition.

The dimensions of the original building were as follows: Engine-house 72'x66' and boiler-house 72'x64', both being about 36' high; those of the addition are; Engine-house 115'x53' 6" boiler-house 130'x45" and both about 35 feet high.

The boiler equipment originally consisted of six 150-hp Wetherill steam tubular boilers, 72"x20', and there has been an addition of ten 125-hp boilers of the same kind 60"x20'. Natural draft is used; the original stack, which is of sheet iron with a brick base and made by the Convery Boiler Company of Philadelpiha is 6'6" diameter and 135 feet high, and the stack for the additional boilers is 10 feet diameter, and 175 feet high The piping is arranged so that any boiler can be connected to any engine. Chapman valves and 12 inch mains are used. The steam pressure is 125 pounds.

The boilers are fed by means of two Worthington duplex pumps 8x6x10 inches, and two No. 10 Monitor Injectors.

The original engine equipment consists of three 250-hp Wetherill engines, cylinder 22"x48"; 75 revolutions per minute; each belted to a 250-hp. Westinghouse 4 pole high speed generator, 525 revolutions per minute. The engine pulley is 18 feet in diameter, 31" face, and that of the generator 31" in diameter. A 36"

* See Philadelphia *Public Ledger*, Sept. 27th, 1894.

idler is used as belt tightener and to increase the contact. The new equipment at present consists of two 750-hp Wetherill-Corliss engines, cross compound, condensing. These engines are directly coupled to a 750-hp Westinghouse multipolar generator of the new type, and are used non-condensing but are arranged to be used condensing if desired. There will be either another 750-hp or else a 1,500-hp machine put in during the coming year.

Two 100-hp Westinghouse compound engines drive the blowers; they are at present on the floor of the boiler house and belt upwards, but they will be removed to a platform under the blowers in order to gain additional floor space.

Fig. 5 is a view of one end of the boiler room, looking in from the street. This shows five boilers on each side, the coal hoppers in the middle and the blowers in the background.

TABLE I.—CAPACITY OF THE POWER STATIONS.

Stations.	Floor Space.		Boilers.			Engines.			Generators.			Cars Oper'ed at present.
	Boiler Room.	Engine Room.	Make.	Present H. P.	Ultimate H. P.	Make.	Present H. P.	Ultimate H. P.	Make.	Present H. P.	Ultimate H. P.	
A Sutherland Ave.	10,458	10,904	Wetherill.	2,150	2,150	Wetherill.	2,250	2,250	Westinghouse,	2,250	2,250	52
B 13th & Mt. Vernon Sts.	13,700	14,280	Babcock & Wilcox. Double-Deck.	3,750	7,500	Westinghouse. Wetherill.	3,000 3,000 6,000	3,000 6,000 9,000	Westinghouse.	6,000	9,000	270
C 33d & Market Sts.....	11,637	11,784	Babcock & Wilcox. Double-Deck.	3,000	6,000	Westinghouse. Wetherill.	1,800 1,500 3,300	1,800 4,500 6,300	Westinghouse.	3,300	6,300	70
D 32d & Dauphin Sts.... (Not in operation.)	7,029	7,029	Wetherill. "Berry."	....	2,000	Wetherill.	......	2,250	Westinghouse.	......	2,250	....
	42,824	43,997		8,900	17,650		11,550	19,800		11.550	19,800	392

TABLE II.—CAR ROUTES AT PRESENT IN OPERATION.

Name of Road.	Length of Single Track (Miles).	Length of Double Track (Miles).	Approximate Number of Cars Operated.	Station from which Operated.	Time Interval Between Cars (Minutes).	Date of Starting Up Road.
Catherine and Bainbridge Sts............	5.5	1.	18	Station A	3	Dec. 15, 1892
Morris and Tasker Sts..	5.9	..	14	Station A	4	Sept. 21, 1892
19th and 20th Sts........	6.0	..	20	Station A	3½	July 31, 1894
13th and 15th Sts........	12 0	..	72	Station B	2½	Dec. 16, 1893
12th and 16th Sts........	10.0	..	58	Station B	2½	Jan. 12, 1894
Ridge Avenue..........	....	3.3	36	Station B	2½	April 9, 1894
Manayunk..............	....	3.75	9	Station B	6	July 1, 1894
17th and 19th Sts........	11.25	..	33	Station B	3¼	Aug. 29, 1894
22d and Allegheny Sts..	1.75	4.0	12	Station B	....	Nov. 1, 1894
Spruce and Pine Sts....	8.75	..	20	Station B	3½	Oct. 22, 1894
Chestnut & Walnut Sts.	3 7	2.0	40	Stas. B&C	3½	July 12, 1894
Philadelphia and Darby	....	4.7	9	Station C	6	June 23, 1894
Lancaster Avenue......	3.7	2.3	35	Station C	3½	May 29, 1894
49th & Woodland Ave..	3.7	2.4	16	Station C	5½	Sept, 22, 1894
Totals	72.25	23.45	392			

13th and Mt. Vernon Sts..—Station B.

This station was the second one constructed and is the largest of all. The engine, dynamo and boiler rooms are located at the northeast corner of 13th and Mt. Vernon streets, a general plan of which is shown in Fig. 3, and a view of the exterior of this, as well as the Mt. Vernon street end of the boiler house is shown in Fig. 4. The Mt. Vernon street front, which is 100 ft. long, is built in three floors, 21 ft. wide, in which are the offices of the engineering staff, the draughting room and testing room. Back of them and extending along 13th street is the engine and dynamo room, which is 146′ 5″ long, 97′ 6″ wide, and 60 ft. high. The boiler house is 169′ 6″x80′ 10″ and about 60 ft. high, and contains at present 10,375 hp Babcock & Wilcox double-deck boilers, and has room for 10 more, 5 of which are now being installed. The boilers are arranged on opposite sides of a 20 ft. passageway in batteries of five, another passage, also 20 ft. wide, crossing this and leading to a side street. Over this passageway the economizers are located, and at the crossing of the two passageways are the blowers and stacks. Induced draft is produced by four Sturtevant blowers, one for each battery, and placed between the economizer and the stacks. There are two iron stacks, one for each side of the boiler house, but placed together in the center over the blowers. They are 10′ 6″ in diameter and the top is 27 ft. above the blowers and 70 ft. above the grates. There is a flue leading from each battery of boilers to an economizer and then to a blower. The two blowers of the boilers on one side, exhaust into a common stack.

There are two ash tunnels, 7 ft. wide and 7 ft. 8 in. high, running the entire length of the building, one under each row of boilers. Ash hoppers under each boiler extend into this tunnel and thus the ashes are readily removed.

The water supply at present is from the city mains, but an artesian well is being bored from which an ample supply is anticipated. The well is to be 8″ in diameter and 200 ft. deep;

FIG. 2.—EXTERIOR OF STATION A, SUTHERLAND AVENUE.

it was begun in September, 1893, and is estimated to be completed in June, 1895. An 8″ water main leading from the city mains is used at present. Two Worthington Compound Duplex pumps are used for the feed water and they are connected to the 8″ main as well as to two storage tanks of a capacity of 63,246 gallons. These pumps have steam cylinders 12 and 18½ inches in diameter and 10¼ inch plunger, with a 10-inch stroke, and are capable of delivering form 530 to 890 gallons per minute. The feed water is heated by four 2,500-hp Goubert heaters, placed in the engine exhaust, which raise the temperature to betwen 125° F. and 200° F., and also by four Green Economizers which raise the temperature about 70° more. These are both rather unusually large sized heaters but they are working very well and giving perfect satisfaction. The feed water circuit is from the street main and tank, through the pumps, exhaust heater and economizers to the boilers. Hercules oil injectors are used on the exhaust of each pump to supply oil to

the feed water and thus prevent scale. 150° kerosene is used, and about 6 gallons are fed in about 24 hours for 2,000 hp. It is being tried as an experiment, and has worked successfully so far. Each boiler is equipped with a "Korting No. 14 injector connected to the street main, by way of precaution.

elevating conveyor and taken to the coal hoppers under the roof, and over the fire room. Large iron pipes lead from the hopper to the floor of the fire room, and the supply can be regulated by the fireman. Two 35-hp Westinghouse compound engines drive the conveyor, and there is an emergency conveyor in the center of the

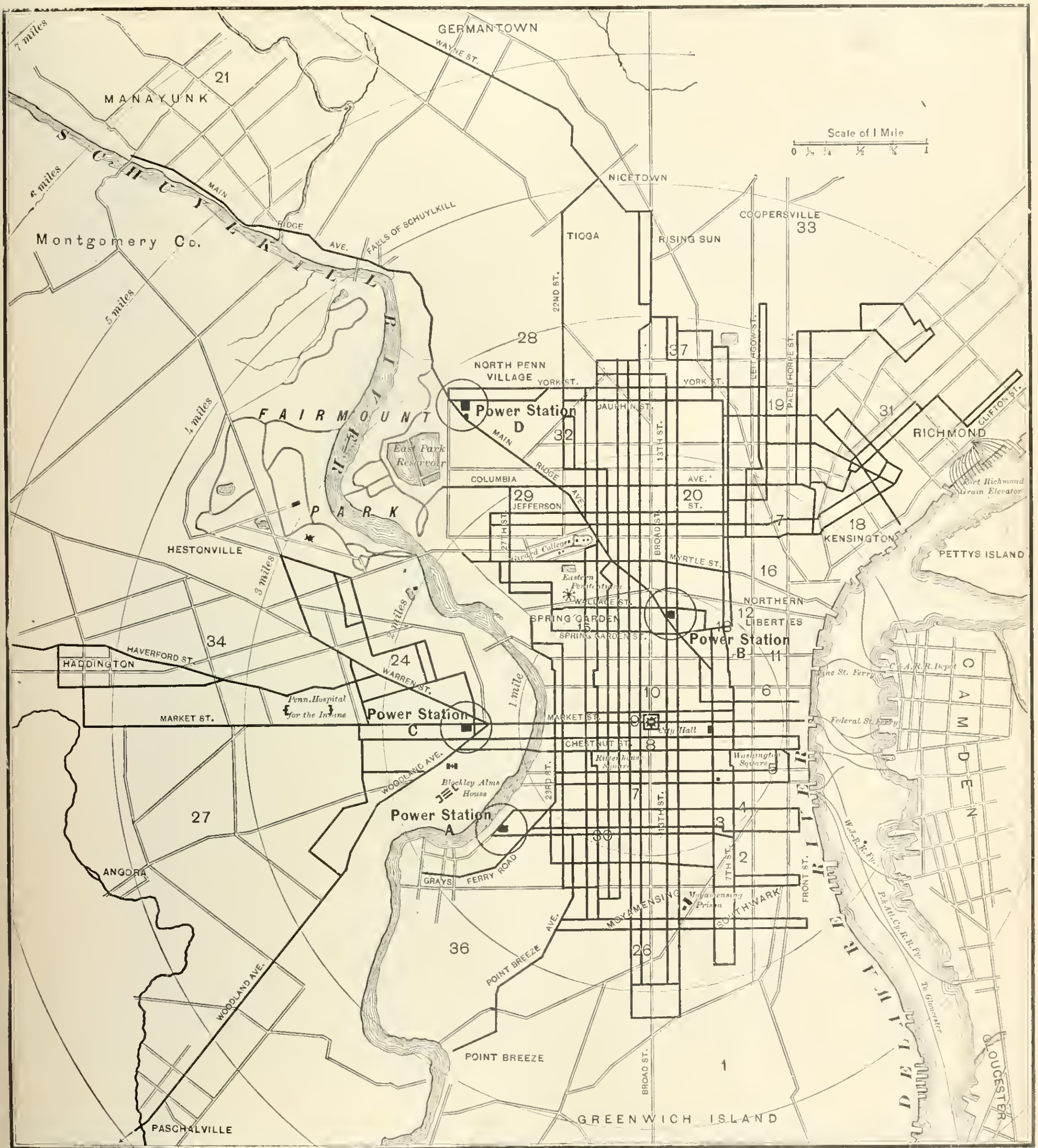


FIG. 1.—ELECTRIC RAILWAY SYSTEM, PHILADELPHIA TRACTION COMPANY.

The coal conveyor supplied by the Link Belt Engineering Company, is a very extensive one. The coal is delivered at a side door, where it is weighed and dropped into a trough from which it falls into the horizontal spiral conveyor which takes it along the basement to the vertical conveyor. There it is dumped into the

boiler room. The storage capacity is about 400 tons. Tupper grate bars are used in the turnaces and they are spoken of as giving good results.

There is a special blow-off tank for the boilers, and all the drips are collected in a well, before running off to the sewer.

There is nothing of special interest about the piping, except possibly the large reverse bend copper expansion joint, placed in the leads from the boilers to the main. There are five of these and they are 10 in. in diameter, 5-16 in. thick, 10′ 6″ long and have a radius of 3 ft. 6 in.

Anthracite pea coal is used and at present about 60 tons a day are consumed, three firemen and two cleaners being at work continuously. The steam pressure in the boilers is kept at 140 pounds.

Fig. 6 is a view of the interior of the engine room, showing about 60 per cent. of the power equipment. In the front are two of the 1,500-hp Wetherill engines and Westinghouse generators; back of these the five "Kodaks," and extending along the south and partly along the west wall, is the Switchboard.

The equipment consists at present of 5 Westinghouse vertical automatic compound engines, each directly coupled to Westinghouse four pole generators, located in a row at the south end of the building. These engines are rated at 600-hp with 140 pounds initial pressure and a speed of 215 revolutions, but are now running at about 120 pound initial pressure and 205 revolutions per minute. The cylinders are 23″ and 40″ in diameter and the stroke is 20 inches. They are what have been popularly called the "Kodak" type, and middle and 18″ at the bearings and is made of cast open hearth steel. The bearings are made extra heavy and all precautions taken in the design and construction to make the entire machine as serviceable for railway work as is possible. These engines, as well as the 750-hp machine in the other stations were built by Robert Wetherill & Co., Chester, Pa.

This generator is of the same type as that exhibited by the Westinghouse Company at the World's Fair, and those supplied for this station are the first machines of this size that have ever been run. Six of them have been ordered by the Philadelphia Traction Company; four for this station and one each for the Sutherland and Market street stations. This generator has 10 poles placed radially on a circular yoke 12′ 6″ outside diameter. The armature is 90″ and the commutator 60″ in diameter.

The engine-room is equipped with a 10-ton and a 20-ton Sellers crane, one of which is equipped with electric propulsion and the other with hand propulsion apparatus, but both have hand hoists. These cranes are also shown in Fig. 6. Two immense Stratton separators, the largest ever built, are placed in the steam mains and have a capacity of from 4,000 to 5,000,-hp each. The piping is all in the basement except the leads to the engines, which have 8 ft. risers and a semi-circular copper expansion joint forming the connection

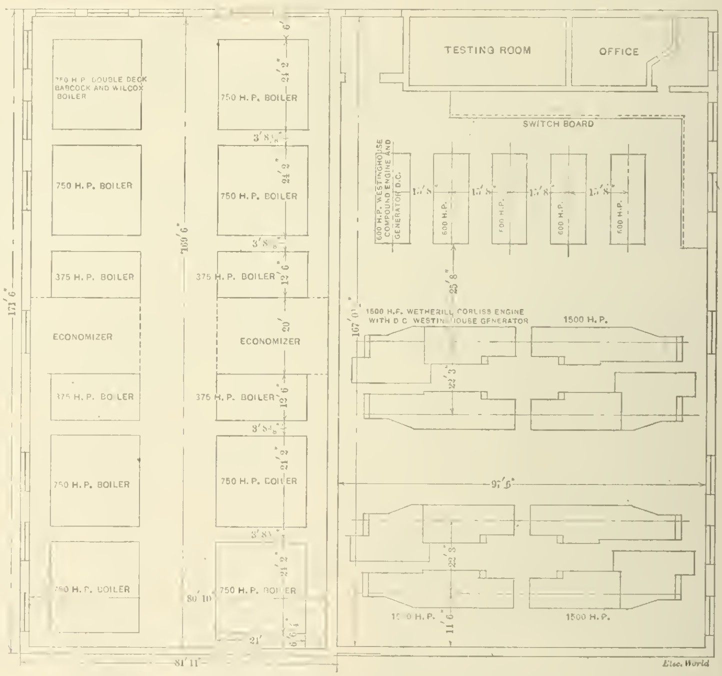


Fig. 3.—Plan of Mt. Vernon Power House.

have given very little trouble so far, as they are given every attention by very competent engineers who have charge of them. These engines are thrown on or off according to the load, but the average operation is about as follows: One engine runs 24 hours, one 22 hours, one 20 hours, one 16 hours and one five hours. They alternate on different days, so that each engine runs about the same number of hours.

The rest of the equipment is eventually to consist of four 1,500 h.p. machines, but at present only two are installed, one of which is running and the other about to start. Two of these machines are shown on Fig. 6.

The engines are Wetherill Corliss twin tandem compound engines and the generator is placed between them on a continuous shaft. The cylinders are 26″ and 40″ in diameter; the stroke 48 inches; and the speed 80 revolutions per minute. They are rated at 1,500-hp at 135 pounds initial pressure. The twin engines are 22′ 3″ between centres. The fly wheel is 21 ft. in diameter and its rim weighs 100,000 pounds, being made especially heavy to steady the speed under the variable load. The shaft has a diameter of 21 7-8″ at the from the riser to the throttle, which are also partly shown in Fig. 6. The oil-circulating pumps of the Westinghouse engines have been recently equipped with oil and water separators to prevent water from being pumped instead of oil, which sometimes happened formerly, but is now entirely avoided. The plant is equipped with 24-inch Lyman exhaust heads.

The switchboard extends along the south wall for 62 ft. and along the west wall 34, making a total of 96 ft. At present it controls about 100 feeders, but its ultimate capacity is 250. Fig. 7 is a view of this switch-board, and also the row of "Kodaks" shown in the background of Fig. 6. The lower panels contain the switches, etc., of the generators, and the main feeder switches, and the upper panel the individual feeder switches, meters etc. The connections are practically the same as for railway switch-boards in general, namely, on the generator panels, a main triple pole, double throw switch, connecting the positive, negative and equalizing leads from the generators to the two sets of positive, negative and equalizing bus bars behind the panels. The ammeter and circuit breaker are connected between the switch and the generator on the negative lead.

Below the switch is a voltmeter plug, which is connected to the leads of the machine, and also a field rheostat. The principal use for the double sets of bus bars, is that one of them may be kept at a higher voltage, for distant points; they can also be used in case of accident to the others.

The main positive bus bars are connected through eight 4,000 ampere switches and ammeters to the feeder bus bars from which the taps are made for the individual feeders. The panels of the individual feeders contain a single pole, double-throw switch, one upper and one lower terminal being connected with taps on the two bus bars; and the middle terminal with the circuit breaker, ammeter and lightning arrester and feeder cable. Fig. 8 shows the connections of a few panels of the switch-board at 13th and Mt. Vernon streets, except that they omit the main feeder switches between generator and feeder bus bars. Weston ammeters are used on all the switch boards of this company.

FIG. 4.—EXTERIOR OF STATION B, MT. VERNON STREET.

FIG. 9.—EXTERIOR OF STATION C, MARKET STREET.

The negative bus bars are connected with the return feeders and also with the earth. The bus bars are mostly 3″ copper bars, 21 feet long, supported on insulation and tapped by means of split collars which are clamped on. The switch-board is constructed of an iron framework, into which slate panels are set and the instruments fastened on these. The switch boards of this station, as well as some of the others, were built by Andrew H. Haig, a well-known engineer and machinest of Philadelphia.

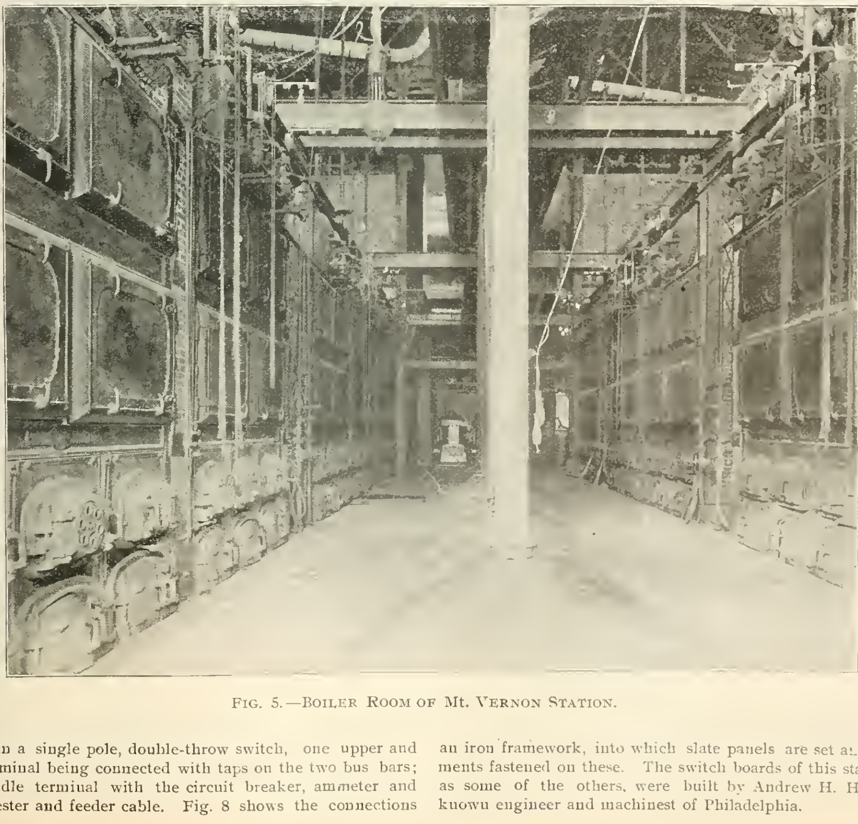


FIG. 5.—BOILER ROOM OF MT. VERNON STATION.

33d and Market Sts.—Station C.

This station feeds all the lines west of the Schuylkill River, and was the third one constructed. In a general way it resembles the station at 13th and Mt. Vernon streets, most of the apparatus being duplicated. Fig. 9 gives a view of the exterior.

The boiler room, which is 147′ 4½″ x 79′, is equipped at present with 8-375-hp Babcock and Wilcox double-deck boilers, the ultimate capacity of the house being 16 in all, in batteries of four, eight

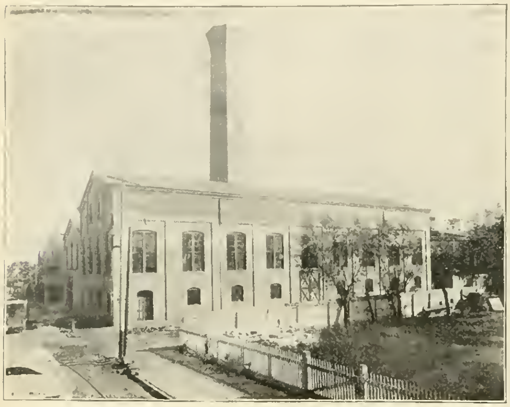


Fig. 10.—Exterior of Station D, Dauphin Street.

being placed on opposite sides of a passage way. Two of them are equipped with Cox stokers by way of experiment.

The boilers are independently connected to two 8″ and two 16″ pipes, with bi-passes, valves, etc., to render the system as flexible as possible. Induced draft is used in this station and the arrangements are similar to those at 13th and Mt. Vernon streets, namely, 4 Sturtevant blowers, 4 Green economizers and 2 Goubert heaters. The bi-pass valves are 20″ Fairbanks, which are among the largest high pressure valves ever made. The Link-Belt Coal conveyor is also similar, except that the coal storage is outside of the building; the ashes are also handled in practically the same manner. There are two water tanks with duplicate street connections and two Worthington compound duplex pumps, which can be connected either to street service or tanks. These pumps have 10 and 16-in. steam cylinders, 8½″ plunger and 10 stroke, and are capable of delivering from 365 to 610 gallons per minute. The economizer and heater have bi-passes, so that the feed water circuit is independent of their operation. Each boiler is also equipped with a "Korting No. 14" injector.

The four Sturtevant fans are each operated by a 25-hp Westinghouse engine and there are two conveyor engines and one stoker engine of the same size.

The engine and dynamo room, which fronts on Market street, is 147′ 4½″ long, 80 ft. wide and 50 ft. high. It contains at present three 600-hp Westinghouse compound engines directly connected to four pole generators of the "Kodak" type and one 1,500-hp Wetherill Corliss engine and Westinghouse generator, duplicates of those at the 13th and Mt. Vernon station already described.

During the next year another of these 1,500-hp machines will be installed.

The valves are all within reach of the platform around the engines and those from top of boilers have the original valve wheel in addition to extension spindles, and additional wheels so as to shut off steam in the boiler room in case of serious accident. They can also be shut off from the engine room platform.

The station is also equipped with one 10 ton and one 20 ton Sellers' crane, with electric propulsion but hand hoist. The switchboard is practically the same as in the other stations, as well as the testing room, vaults, etc., which have already been described.

32d and Dauphin Sts.—Station D.

This station, which is now being constructed, is to feed the circuits in the northern section of the city. Fig. 10 shows the exterior of this station, which differs from the others in being built of light yellow brick instead of red. The building at the corner is the engine and dynamo house, the next the boiler house and the last the new car shed, capable of holding about 200 cars. Fig. 11 is a plan and elevation of this power station showing the location of the machinery, the distinctive feature here being the use of vertical boilers, the other stations all having horizontal boilers.

The boiler house, which is 142 ft. long, 49.5 ft. wide and 35 ft. high, is to be equipped with eight 250-hp Berry fire tube vertical boilers with natural draft. The brick stack is 8 ft. diameter and 128 ft. high.

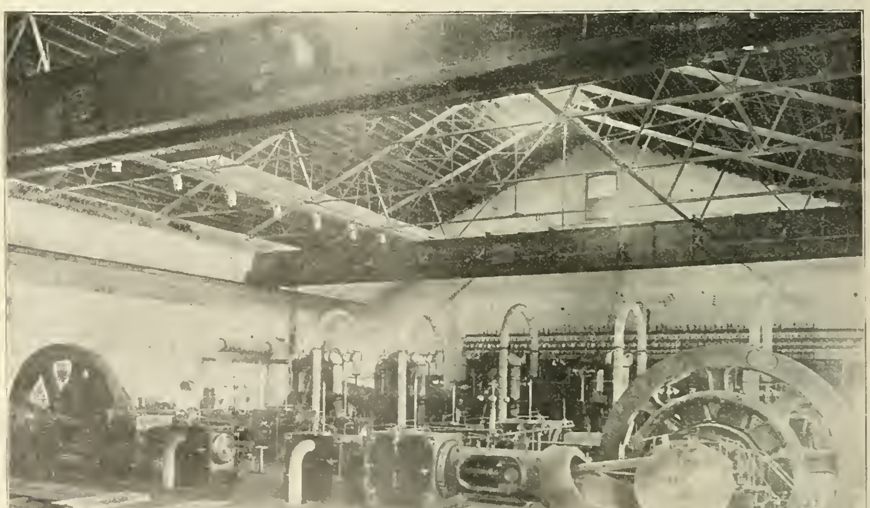


Fig. 6.—Completed Portion of Engine Room, Mt. Vernon Station.

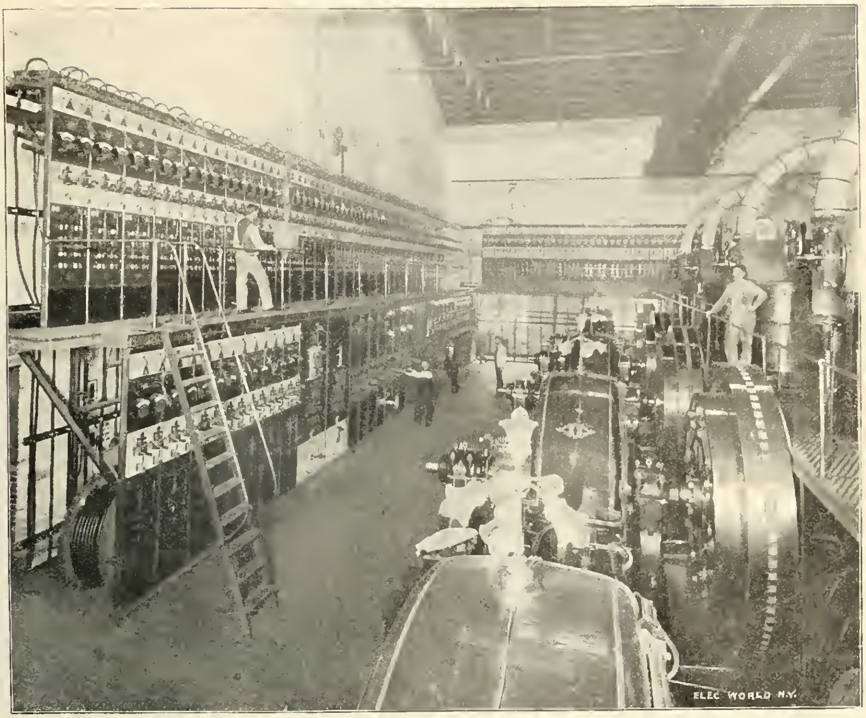


FIG. 7.—SWITCHBOARD OF MT. VERNON STATION.

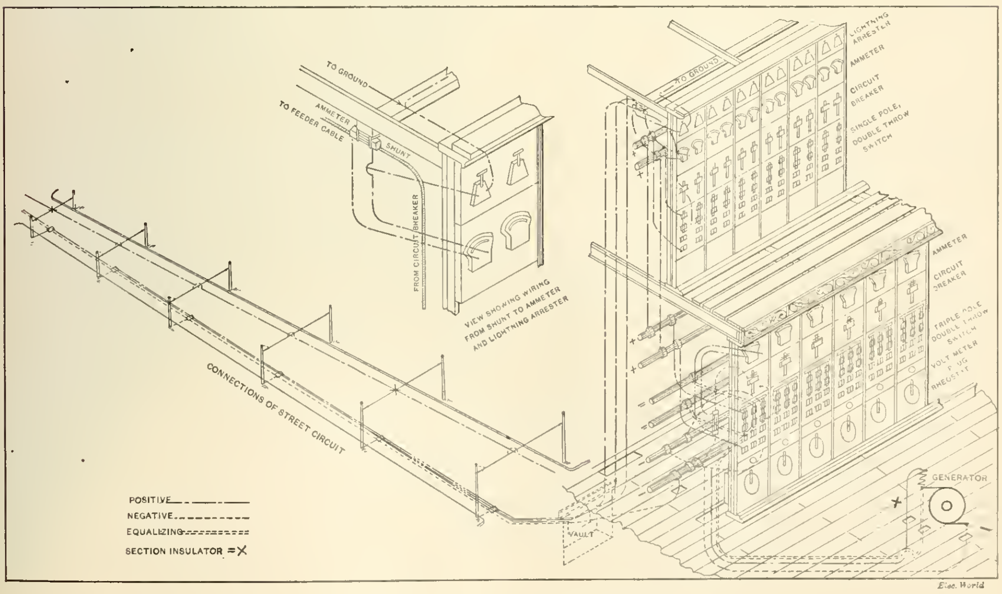


FIG. 8.—SWITCH BOARD CONNECTIONS.

The engine house, which is 142 ft. long, 49.5 ft. wide and 35 ft. high is to be equipped with three 750-hp Wetherill-Corliss cross compound twin engines directly coupled to Westinghouse generators similar to those already described.

The switchboards, vaults, etc., will be similar to those of the other stations.

All of the buildings and stacks built for the electric system of this company were the work of Samuel Hart & Son, of Philadelphia, and reflect great credit upon these builders, as the construction work seems to be thoroughly substantial, well adapted to the desired purposes, and withal in very good taste without any extravagant ornamentation.

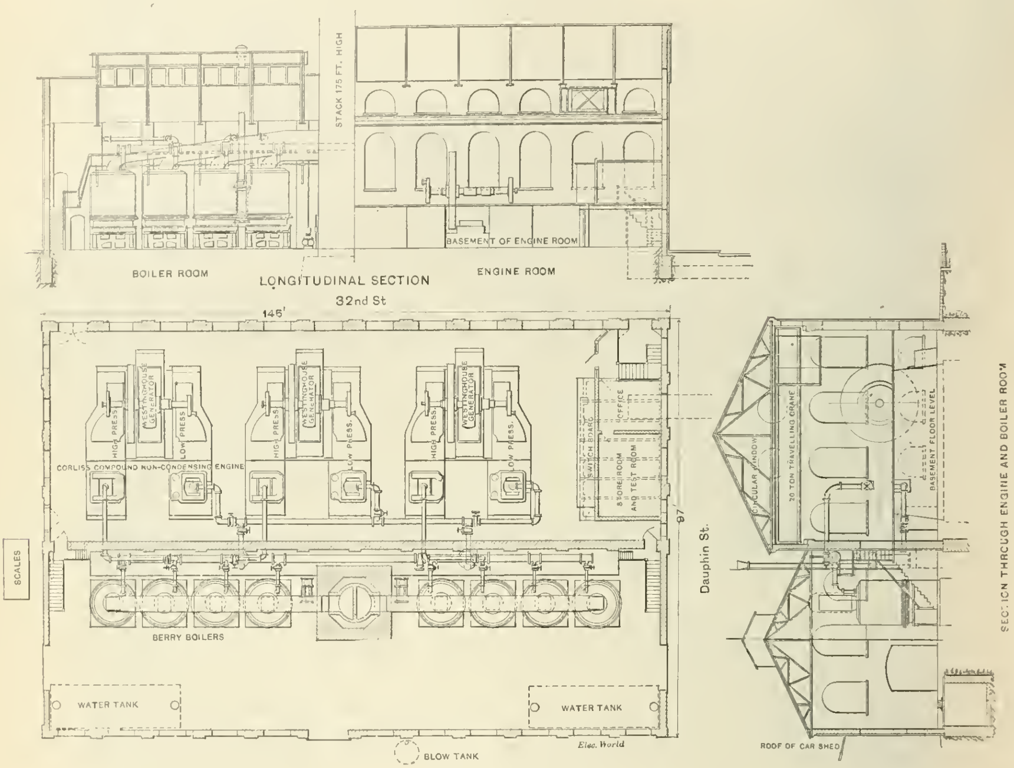


Fig. 11.—Dauphin Street Power Station.

Storage Battery Litigation.

Judge Lacombe, of the U. S. Circuit Court for the Southern District of New York, on October 10 granted a preliminary injunction on the application of the Accumulator Company of Philadelphia, against the Edison Illuminating Company of New York, restraining the latter from installing storage batteries manufactured by the Electric Storage Battery Company of Philadelphia.

The court said that in considering the application for a preliminary injunction in the present case, the construction laid down in Judge Coxe's opinion sustaining the patent of the Accumulator Company, whose infringement is alleged, will be adhered to. The claim of the patent in that suit was for secondary batteries having perforations or cells extending through the plates, and the active material, or material to become active, packed in the perforations or cells only. Judge Coxe held that the combination, in which the perforations extended through the plate and the material filled the perforations only, was original with Swan; that it was not only new but a useful and important advance in the art, and that the idea which has made these plates a commercial success was first given to the world in a practical embodiment by Mr. Swan. Judge Lacombe adds that no new evidence tending to modify this opinion has been introduced, so that the only question to be decided is whether the defendants' plates infringe.

As the plates alleged to infringe are perforated, the perforations extending through with active material embedded in them, he holds that infringement by the completed structure is so plain that the defendants have been constrained to insist that Swan's patent is practically for a process, and, therefore, as defendants' process is a different one they claim there is no infringement; they also insist that the material which they use is not active when the process of packing antimonious lead around it is complete, and that it does not become active the moment it is placed in the battery fluid, but requires further electrolytic treatment.

In regard to these claims the court states that manifestly the result is the same whether the material is packed within the bounding walls of the perforations or whether the bounding walls are packed around the material; and the complainant's patent is not confined to active material, but includes "material to become active," and whether it becomes active through one process or another is practically immaterial. The gist of Swan's invention, as defined by Judge Coxe, was the confining of the material which was to do the work, within perforations which extended completely through the plate.

While defendants did manufacture and sell cells for some years their plates were not the same as the plates now complained of. Both were equally infringements of the patent, but the complainants state that they did not prosecute the infringement by the early plates for the reason that they did not believe them to be commercially harmful. The grounds for that complaint are said to be the relative size of plate and button. In the latter plates the loss by accident while in use of the contents of a single cell, would not, it is asserted, practically destroy the usefulness of the plate, being only a loss of 1-256ths of the active material. A similar accident, however, to the older plate would destroy its usefulness, as a single perforation holds one-ninth to one-twelfth of the active material. This explanation seemed to the court a reasonable excuse for failing to prosecute them against the older plates.

The Street Railways of Atlanta.

Atlanta has a greater mileage of street railways in proportion to population than any other city in the United States. With the exception of .8 of a mile of track over which a mule car is daily hauled to hold a franchise, this mileage is operated entirely with electric cars. The visitor to the Street Railway Convention will find, in all, three street railway companies, each operating separate lines, aggregating, in equivalent length of single track, 96 miles of line. On these lines almost every type of electric railway motor is in use, from the old Sprague No. 6 to the latest types of the single reduction motor, thus affording a good opportunity to the inquiring visitor to compare the relative advantages and the practical workings of the different makes.

There is no doubt but that the street railways of Atlanta are at present somewhat in advance of Atlanta's needs, but that the city will soon grow to need them all and some more in addition, those who know anything of Atlanta's growth and spirit, most confidently assert. In 1880 the population was 37,000; in 1890 it was 65,533 and at present it is over 100,000 and estimated at 110,000. With such a rapid growth as this the street railways of Atlanta will certainly not lack for patronage in the future.

The largest street railway company in Atlanta, and the one operating on the principal streets of the city is the Atlanta Consolidated Street Railroad Company. This company was formed, as its name indicates, by the consolidation of all the old street car lines of the city, and was chartered May 16th, 1891. It is the consolidation of the Atlanta Street Railroad Company, the Gate City Street Railroad Company, the West End and Atlanta Street Railroad Company, the Fulton County Street Railroad Company, the Atlanta and Edgewood Street Railroad Company and the Metropolitan Street Railroad Company. All of these companies, except the last two, operated their lines with mules and all were electrically equipped by the Consolidated Company. The Atlanta and Edgewood Street Railroad line was the first one equipped with electric cars (in 1889, 1890), and was operated with the old double reduction Thomson-Houston motors. The Metropolitan Street Railroad Company operated a steam dummy line from Atlanta to Decatur, and the motive power has only recently been replaced by electricity, thus completing the electrical equipment of the entire system. The Atlanta Consolidated operates 52¾ miles of main line, with 11 miles of second track and sidings, forming a total length of 63¾ miles, 33 of which run through paved streets. The greater portion of the line is laid with 40-pound T rail, some 44 miles, the balance of 19½ miles consisting of 40-pound to 56-pound girder, four miles Providence girder and 15 miles of Johnston girder rails. The rails are supported on pine and oak ties laid in sand, an intermediate stringer being used for the T rail where it is used on the paved streets.

The overhead construction consists of a number O copper trolley wire, supported by hangers of the General Electric type; throughout a radius of one-quarter of a mile from the center of the city 27 feet Walworth iron poles are used, wooden poles being used on the remaining portion of the system. Bracket construction is used only on lines outside of the city, all the city lines having a span supported trolley. For the ground return a number O, supplementary copper wire is connected to rails on both sides of each joint. On the lines constructed within the past year and a half, the rails have simply been bonded with No. O copper bonds.

The motor equipment consists of 108 General Electric S. R. G., 15-hp motors (54 double motor equipments), 4 latest type Westinghouse double motor equipments and 2 G. E.-800 double equipments, only single reduction motors are used, as the first equipment of 6 F-20 T-H motors have been discarded.

These motors are fitted to Bemis trucks and are used beneath 47 box cars for winter, and 40 open cars for summer travel. The open cars are 26 ft. in length over all; 20 are Pullman, 8 Brill, 2 Jones, 4 Lewis & Fowler, 2 of Consolidated Company's own manufacture, and 4 made over from old passenger cars used on the steam dummy line. The closed cars have 16 ft. inside length and are mostly all Lewis & Fowler and Stephenson, with a few Brill.

Power is supplied the road from the company's own power station situated in the northeast section of city, and the station of the Georgia Electric Light Company in the western part of the cit

The company's power station is built of brick with wooden trusses supporting a tar and gravel roof. The dimensions of the building are 50x100.

In the boiler room are three return tubular Bigelow boilers, each 6 feet in diameter and 16 feet long with a nominal capacity of 150-hp each. To these there has lately been added one vertical Manning boiler of 250-hp capacity.

The engine and dynamo room originally contained two 250-hp Cooper-Corliss Engines with cylinders 20x42, which were belted to a line of counter shafting, to which in turn were belted seven 85-hp T-H generators of D-62 type. About a year ago the company decided, in the interests of greater economy, to replace these small sized generators with large units, and so made a contract with the Westinghouse Company for two 300-kw, and one 500-kw railway generators. The countershafting and the D-62 generators were taken out and the two 300-kw dynamos were put in position and directly belted to the two Cooper-Corliss Engines. In the centre of the engine-room a Rankin-Fritch compound condensing engine has been installed, directly coupled to the 500 kw generator. This engine makes 90 revolutions per minute, has cylinders 22″ and 40″ in diameter with 48″ stroke, exhausting into an independently operated Smith-Vaile duplex condenser, having steam cylinders 12″, and water cylinders 16″, in diameter with 24″ stroke. Water is supplied from a tank 8½ ft. deep by 55 ft. in diameter, and is kept cool for condensing work by pouring it over a twenty-foot fall inside of a large wooden box. In the sides of this box are four 6-ft. radial fans driven by two R. G. motors which force a current of cooling air upon the cascade of water returning from the condenser. The station is situated along side of the main line of the Railway Company, and receives its coal cars on a trestled side track where the coal is dropped through upon a chute and delivered to the door of the boiler room.

Adjoining the station are the car barns, two large frame buildings, 80x120 feet each fitted with pits, transfer tracks, etc., for the proper storing, handling and cleaning of the cars. In one of these barns is a complete carpenter shop, where the company manufactures its own car bodies. Between the barns and station is the machine shop 25x50 feet and foundry 30x30 feet.

The foundry has a brass furnace and a small cupola iron furnace permitting the company to cast its own journal brasses, trolley wheels, brake shoes, axle gears, gear cases, car fittings, etc.

The machine shop is operated by a 15-hp Thomson-Houston stationary motor, and contains lathes, a drill press and other machinery for the finishing and fitting up of repair parts and castings.

Power for the lines in the eastern part of the city is furnished from the station of the Georgia Electric Light Company. This station is 129x153 ft., and is built of brick with iron roof trusses.

The Atlanta Consolidated has installed here five 90-kw General Eletctric multipolar generators. The Georgia Electric Light Company operate them and furnish power by the meter at a charge of 2.7 cents per kilowatt hour. The engines that are specially used for driving the railway generators are two tandem compound condensing McIntosh & Seymour high speed engines with cylinders 14½″x23″ with 22″ stroke; each engine has a rated capacity of 500-hp. These engines are belted to a line of counter-shafting which transmits by pulleys and Eclipse clutches to any desired generator. The capital stock (common stock) of the Consolidated Company, authorized and issued is $2,000,000, the par value per share being $100.00. Of the $2,250,000 of first mortgage gold bonds authorized, there are issued and outstanding $1,953,000 and $225,000 reserve, held to retire outstanding gold bonds of the Atlanta Street Railroad Company. In addition $72,000 are in the hands of trustees for cost of additions to property. These bonds are coupon bonds, due 1921 and of $1,000 denomination. The original interest was 6 per cent., but this was scaled down by agreement in November, 1893, to 3 per cent. for two years ending July 1st, 1895, and to 5 per cent thereafter for the life of the bond. The stockholders in Nov., 1893, were assessed to pay the floating debt and received $212,000 in income gold bonds which bear interest at 8 per cent. and fall due in 1924. The following is a statement of the operating expenses and earnings for the years 1893 and 1894:

OPERATION, YEAR ENDING APRIL 30, 1894.

	1893.	1894.
Gross receipts from passengers	$351,568	$299,311
" " " other sources	510	329
" " total	$352,078	$299,640
Operating expenses	249,528	205,119
Earnings	$102,820	$94,521

DEDUCTIONS FROM EARNINGS.

		1893.	1894.
Interest charges	$97,524		
Taxes	14,066		
Miscellaneous	7,974		
Deficiency	25,043		
Per cent. of operating expenses to totals receipts		70.7	68.3

The average car mileage per day is 4,500, giving a passenger income per car mile for 1893 of 21 4-10 cents and for 1894, 18 2-10 cents. The operating expenses per car mile for 1893 were 15 9-10

cents and for 1894, 12½ cents. Annual increase per mile of street for 1893 was $6,633.17 and for 1894, $5,647.40.

The following is the last balance sheet:

BALANCE SHEET APRIL 30, 1894.

Assets.		Liabilities.	
Road and Equipment	*$4,392,925	Capital stock	$2,000,000
Cash assets	22,624	Bond account	2,153,000
Material	4,658	Income bonds	212,000
Bills Receivable	758	Accrued interest	29,363
Miscellaneous	798	Accounts payable	20,094
		Reserve	7,306
	$4,421,763		$4,421,763

* Including profit and loss, $121,127.

The officers of the company are as follows: President, Joel Hurt; Vice-President, E. Woodruff; Secretary, T. K. Glenn; Treasurer, R. J. Lowry; General Superintendent, H. N. Hurt; Purchasing Agent, W. H. Glenn; Electrician, N. W. L. Brown.

This road is one of the finest pieces of street railway property in the South. While there are portions of the road at present unprofitable, such lines will in a short time prove remunerative. The road has been put through a rigid system of economy for the past year. Conductors have been dispensed with on many lines, thus effecting a marked saving. Everything points to a successful future for this company.

The Atlanta Traction Company sprang from the consolidation of three roads. The first part of the road built was known as the Atlanta, West End & McPherson Barracks Railway, running from Atlanta to the United States barracks. This was built in 1890, and in 1891 a connecting line was constructed to Grant Park by the Grant Park Electic Railway Company, which was composed of practically the same men as the original company. These lines were in 1892 consolidated under the name of the Atlanta Traction Company. In 1892-1893 the Atlanta City Street Railway Company constructed a line running from Atlanta to Decatur & East Lake. In March, 1894, this was consolidated with the lines of the Atlanta Traction Company, a mile of connecting road was constructed, and the whole came under the name and management of the Atlanta Traction Company. In May, 1894, the road was placed in a receiver's hands.

The combined lines form 22 miles of single track road, no double track being used except in crossing a bridge in the centre of the city. The road is laid with 40 pound rails on sawed ties, the rails being bonded and cross connected with number 0 copper wire. The overhead line consists of No. 0 trolley wire with both cross suspension and bracket construction.

The rolling stock consists of 26 cars, 13 closed and 13 open. Of these 17 are Brill, 66 American, 3 Rogers, and 2 second-hand Rogers from the West End Railway Company, of Boston. There are four double bogie truck, Brill, extra long open cars, two of them equipped as double-deckers. The trucks are of Brill, Rogers, Graham and McGuire construction.

The motor equipment is quite diversified for one road, and consists of five double equipments of the old Edison No. 6 double reduction motors, eight double equipments of Westinghouse single reduction motors, four of latest type, two double equipments of Edison No. 16 single-reduction motors, and six Detroit 30-hp double reduction motors. There are also on hand two Detroit single-reduction 50-hp. motors, which are not used.

Each of the two separate companies contsructed its own power house, and the great length of road running from east to west through Atlanta makes the use of two power stations very necessary. These stations are situated in the eastern and southwestern parts of the city. The power stations of the original barracks line is a brick building 70x50 on the line of the E. T V. & G. R. R. running south of Atlanta.

A 12-hp Russell return tubular boiler and two 125-hp McLaughlin upright tubular boilers furnished steam for two Russell engines. One engine with cylinders 14x20 inches, and of 125hp capacity, is directly belted to an Edison two-pole 80-kw dynamo, and the other engine of 250-hp capacity, cylinder 20x27 inches, drives two Eddy 110-kw multipolar dynamos. Adjoining the power house is a frame car barn 100x80, and the machine and repair shops of the road.

For the eastern section of the road power is furnished from a brick station 30x50 feet, situated along the main line of the Atlanta Charlotte Railway (Southern Railway Company). Power is furnished here from two 100-kw Detroit dynamos, driven with direct belting by two 125-hp Russell engines, having cylinders 14x20 inches. Steam is furnished from a battery of two 125-hp Chattanooga return tubular boilers. Adjoining this station is another frame car barn for storing cars on eastern end of the line.

In the operation of the road cars run on regular twenty minute schedules, keeping five cars in regular operation. Motormen and conductors receive 12 cents per hour, an average day's work being 12 hours; engineers, $60 per month, and the superintendent $75 per month. The following is a statement of earnings and expenses for the month of August, 1894. The expenses are very heavy from the fact that the road and equipment were in bad condition when placed in the receiver's hands, and have had to be fully repaired. Much of what is charged up to expenses is properly betterment and improvement.

EXPENSES.

	July, 1894.	August, 1894.
General Expenses—		
Salaries of officers and clerks, insurance, etc	$547.78	$1,349.99
Transportation Expenses—		
Car Service	1,771.38	1,727.74
Car-house and power-house, oil, etc	924.42	697.85
Fuel	818.72	571.65
Maintenance of Way and Buildings—		
Repairs, roadway and track	222.21	247.12
" buildings and structures	19.92	2.15
" and renewals, overhead line	112.16	111.25
Maintenance of Electric Equipment—		
Repairs of cars	212.49	281.65
" electric equipment of cars	616.31	573.04
" steam plant	4.78	23.06
" electric power plant	10.90	.60
" tools and machinery		4.05
Miscellaneous expenses	98.25	41.00
Total	$5,339.32	$5,631.15

RECEIPTS.

	July, 1894.	August, 1894.
Gross receipts from passengers	$5,988.35	$6,186.80
" " other sources	10.00	92.50
Total	$5,998.35	$6,279.30
Per cent. operating expenses to total receipts	89. p.c.	89.6 p.c.

The floating debt is about $25,000. Car mileage, 2,500 car miles per day.

	July, 1894.	August, 1894.
Passenger Insurance per car mile	6$\frac{8}{10}$c.	7c.
Operating expenses " "	6$\frac{1}{10}$c.	6$\frac{42}{100}$c.

The authorized first mortgage gold bonds of the original Atlanta Traction Company amount to $300,000, of which $162,000 are issued. The Atlanta City Street Railway Company had $200,000 of bonds and $200,000 of capital stock. When the latter road was bought in by the Atlanta Traction Company, the $200,000 of bonds was assumed by the Traction Company and the $200,000 capital stock cancelled. Since the consolidation of the roads $75,000 of second mortgage gold bonds have been issued. The first mortgage bonds are coupon bonds dated 1891, due 1916, of $1,000 denomination, and bear interest at 6 per cent. payable in May and November of each year.

The receivers of the road are Judge E. B. Rosser, president of Exchange Bank, and Mr. William C. Hale, president of State Savings Bank, both of Atlanta. Mr. G. W. Evans is superintendent of the road.

The Collins Park & Belt Railway is an example of a road built entirely on credit and without a cent of bonds or capital stock. Projected in 1891, and finished in 1892, this road extends 15 miles westerly from the centre of the city to the Chattahooche River and was known originally as the Atlanta & Chattahooche River Railway. In June 1892, when the road was started up, the Electrical equipment not being ready, a dummy and some cars were rented and put into operation. While so operated a very bad accident occurred, due to spreading of rails, in which several people were killed and a number badly injured. This caused considerable litigation, and the name of the road was changed from the Atlanta & Chattahooche River Railway to the Collins Park & Belt Railway. The lack of patronage, the financial crisis and the pressure of creditors precipitated a change soon after the road was equipped, and a receiver was appointed in the person of Mr. G. F. Darr, in March, 1893.

At present nine miles of the road are in operation. The line is constructed with 56 pound T-rails laid on sawed pine ties, and banded with No. 0 galvanized iron bonds, as well as connected to No. 0 supplementary iron wire. The overhead line is of span construction inside of the city, and bracket supported beyond the city limits. The trolley wire is No. 0 copper, supported by overhead hangers and devices of the Short Company, fed by No. 0000 copper wire. Nine Brill cars constitute the rolling stock, seven 8-seat open cars, and two 16-feet closed cars. These are equipped with Dorn & Dutten trucks and 33-inch wheels.

The motors were first of the single reduction type produced by the Short Company, known as the split diagonal, and are of 20-hp capacity. There are nine double equipments of these motors.

The power station is 100x60, built of stone and situated about five miles from town. The station equipment consists of three 200-hp return tubular Janes boilers, fed by two Worthington

feed pumps with 8-inch steam and 6-inch water cylinders. These boilers furnish steam to two 18x44-inch Allis-Corliss enignes, having 18 feet fly wheels and running at 90 revolutions per minute. These engines are connected by 24 feet belts to two Short 300 ampere railway generators, running at 500 revolutions per minute.

Coal is hauled to the power stations in regular freight cars by the motor cars. The cars run on a regular thirty-minute schedule from 6 a. m. to 8 p. m., making the round trip of 18 miles in two hours. The heaviest grade on line is 7 per cent., which, with a curve, is equivalent to a 10 per cent. grade. The line runs through a sparsely settled section and can only prove a paying line with the building up of the surrounding country.

The estimated cost of road is $250,000. Among other liabilities are the following: Short Electric Railway Company, $50,000; Brill Car Company, $5,000; Venable Bros., of Atlanta, preparing material, $5,000; E. H. Jones, of Cleveland, Ohio,, for steam plant $35,000; C. J. Simmons, of Atlanta, for road construction and power house, $60,000. The gross income per year is $16,000, all from passenger receipts, and the net annual earnings are $3,000. This makes $13,000 for annual operating expenses, giving percentage figure of operating expenses to gross income of 81 per cent. The car mileage is 576 car miles per day, and the gross income per car mile is $7.61. Operating expenses per car mile are $6.18.

The annual passenger income per mile of road is $1,777.

Notes on the Management of Railway Power Stations—III.

BY GEORGE T. HANCHETT.

THE ENGINE.

There is no more trusty servant in the power station than the engine, if it is intelligently managed and well cared for, but it will not bear abuse and neglect.

A new engine, like a recently tightened bearing, requires careful watching on the first days of its running. The bearings should be felt of frequently to be sure that they do not heat. The cylinder and valve chest should be brushed over with cylinder oil and then carefully inspected to see if any bubbles appear on the surface. This will detect "sand holes," and if there be any they should be at once plugged as they will quickly cut larger. Bore them out

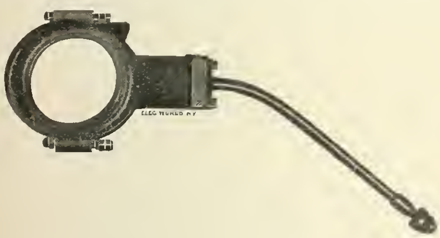


FIG. 8.—BENT ECCENTRIC ROD.

with a small drill, allowing it to enter the plate about one quarter inch. Then tap out the hole with a "bottoming" tap and cutting a tapering thread on a suitably sized wrought iron rod, screw it into the hole till it wedges, and cut off squarely and polish. A hot box is very liable to occur on a new or recently keyed bearing. The following remedies should be tried in the order given, and each should be tried thoroughly before the next one is attempted.

First—Start the oil cups to running profusely.

Second—If the bearing will admit of it loosen the cap screws.

Third—Flood the bearing with cylinder oil or soft soap.

Fourth—Try ice or a steady stream of cold water.

If all remedies have been persistently tried without avail, shut down. If the case has gone so far as to need remedy then the box should be rescraped before the engine is run again.

Ice and water should be used with the greatest caution on a dynamo bearing, if at all. The armature may be ruined by carelessness in this regard. A hot-box should seldom, if ever, cause a shut down. In a lighting plant it is often better to ruin a wrist pin or crank pin rather than shut down, but in a railway power station this is not so necessary.

The cylinder lubricator should always be in the best of order. Failure of the lubricator to work may result in a valve sticking and a bent ecentric rod is the result, Fig. 8. Often this accident is caused by the eccentric strap itself becoming hot and sticking.

In dismounting an engine or other heavy machines the writer has found the simple apparatus shown in Fig. 9. very useful. The figure is self explanatory. A small bar of steel, a short piece of nine or ten-inch pipe, a wooden beam of sufficient strength, a few pieces of rope and a little common sense will produce a temporary crane on this principle that will be very efficient.

To throw a large engine off a dead centre, when there are no means of barring the wheel, is often more or less trouble. Often the engineer does not realize that he has the very agent at command to do this work. Connect the generator to the bus bars of the switch-board interposing one of the switch-board rheostats, being

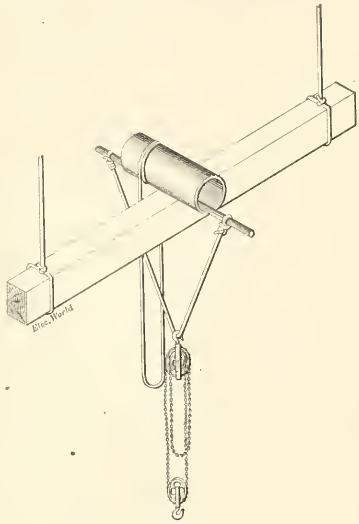


FIG. 9.—APPARATUS FOR DISMOUNTING.

careful to choose a rheostat of sufficient capacity for the purpose. Allow just enough current to enter the generator to overcome the friction of repose and the large engine may easily be turned over by hand.

The writer has by this means turned over a 90-hp plant, in which there were a large number of machines, and long jack shafts making the friction of repose very great. It usually required two men to turn over this plant and the ease with which the writer turned over the plant with one hand excited the wonder of an on-looker, who subsequently tried it himself when the current was off and found that it stuck.

The centrifugal governors of high speed engines often act

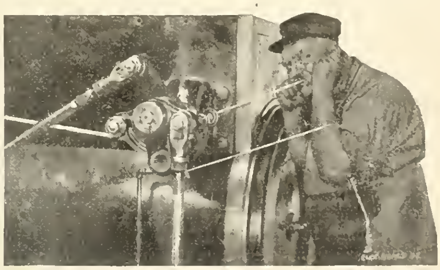


FIG. 10.—DETERMINING ACTION OF ENGINE VALVE.

sluggishly and sometimes stick fast. This will cause a runaway when a portion of the load is thrown off and the consequent rise in voltage is liable to ruin lamps, if they are in circuit. In the case of a power station the rise in speed does not become such a serious matter till it becomes so high as to endanger the fly wheel by excessive centrifugal force. In any event such a governor is to be corrected at the earliest possible opportunity. It should be taken apart, thoroughly cleaned of all old oil and carefully inspected for burrs roughnesses, etc. If these exist they should be removed with a fine file and repolished with fine emery and crocus cloth.

The writer knows of a case where the engineer keeps a fruit can

of oil handy, and whenever his engine races, due to the sticking of the governor, he deluges it with oil in such a dextrous manner as to excite one's sense of the ridiculous.

The writer would recommend this expedient in case of an emergency, but the constant use of such methods is too slovenly to be tolerated.

Much may be learned from the sound of an engine as it runs. Take a pencil between the teeth and close both ears and rest the pencil against the head of the cylinder. With a little practice the hissing sound of the admission and expansion gradually dying away as the exhaust begins and followed by the dull thud of the compression may be readily distinguished. If the valves are of the Corliss type or similar open valve gear a piece of pack thread can usually be attached to the valve and so arranged as to twitch

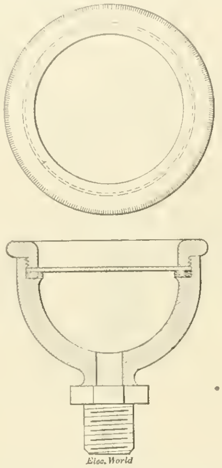


Fig. 11.—Water Relief Diaphragm.

the elbow at the point of cut off This will assist very materially in distinguishing the various events of the stroke. By listening to engines that are set correctly a person can gain very accurate ideas as to how an engine should sound. This method will prove useful principally in estimating whether the compression is excessive. See Fig. 10.

The sound of water in the cylinder needs no stopped ears and lead pencils to detect it. Every station engineer has heard that metallic chink and instinctively opens his cylinder cocks and stands by the throttle. Many a cylinder head could have been saved by the use of a relief valve. If these are not provided with the engine a good expedient is to screw a diaphragm, such as is shown in Fig. 11, into the holes tapped for the indicator cocks. These will burst and relieve the pressure. They are made by several firms and can be fitted to any engine.

To be economical an engine should be supplied with good dry steam, and steam superheated a few degrees is a great advantage.

Hirn's analysis has shown beyond all question the losses of wet steam. The steam enters the cylinder; being hotter than the cylinder it loses some heat to the walls. Then cut off takes place and the steam expands, falling in temperature as it does so. If the steam is saturated when it enters, the losing of heat to the walls precipitates a thin film of moisture thereon. This film is re-evaporated during exhaust by the walls as they are hotter than the steam after it has expanded, and the steam thus formed leaves the engine without having done any work.

If the steam be superheated when it enters, the heat lost to the walls during admission is the heat of the superheat and no film of moisture is precipitated. This heat will be more or less retained by the walls and will be an advantage during admission and expansion rather than uselessly re-evaporating a film of water to be thrown away with the exhaust. Nature has many ways of evading work and this method of dodging around the piston of a steam engine is, to say the least, most ingenious. If too strongly superheated the steam is liable to burn the cylinder oil and cause cutting of the cylinder, and trouble from this source is always serious. There are many forms of superheaters, but all of them are liable to burn out unless they have expert care. The best form of superheater is the common upright boiler, Fig. 12, which has its flue tubes passing through the steam space. Sufficient heat is absorbed from the hot gases by the water at A to prevent the burning of the exposed ends of the tubes at B. These exposed ends do the superheating and such a boiler, well used, will supply superheated steam.

Many station managers do not realize that by having one of the battery of boilers an upright boiler and passing all the steam of the battery through the steam room of that boiler, that a much more economical steam can be obtained.

The station manager should keep a note book devoted exclusively to the engines and dynamos. He should study the load from day to day and strive to so run his engines as to keep them fully loaded at all times during their runs. He should have in his book, among other things,

Time of starting and stopping.

Amount of oil used.

Hot boxes, if any.

Load as given by switch board ammeter and voltmeter.

Gauge pressure at various intervals during the run.

If there is an engine register, the number of revolutions of the run, and from the time compute the average speed.

Remarks comprising any events of interest.

Any cards that may have been taken.

It is not sufficient to take these data down. They must be carefully studied and each day's run must be compared with the rest, constant improvement being the aim.

Cards should be taken at least once in two weeks, and the writer does not hesitate to say that steam units of five hundred kilowatt or over should have the indicators on every day, and cards frequently taken. Every means should be employed to keep the engine running economically at all times. Under good conditions such a unit uses over a ton of coal per hour and too much care cannot be taken in the economy. A change of a small fraction of an inch in the lines of the indicator diagram may mean a loss of fifty cents to a dollar an hour. It therefore should be carefully watched. There are many forms of logs and performance sheets, but each station needs one peculiarly suited to its requirements. The station manager should see to it that some record is kept of the runs.

There is no reason why a railway power station should not be under as close supervision as the financial affairs of a business company. It is perfectly possible to determine exactly the cost of the power and the available power produced no matter how large the station; and there should be sufficient data on the manager's record

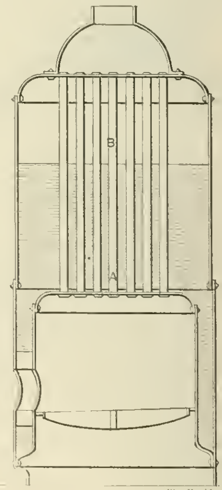


Fig. 12.—Superheating Boiler.

to obtain the cost of the power in cents per kilowatt hour.

Much power is wasted by the ignorant installation and use of small compound units. A compound high-speed, non-condensing unit is seldom economical, and a triple of this type never. Non-condensing compounds must be run at high pressures and be kept full of steam by running at full load, in order to be saving, otherwise the low pressure cylinders are simply air-pumps.

When the load of an engine is widely varying such units should never be employed.

(To be Continued.)

Street Railway Repairs.

BY J. B. CAHOON.

The question of repairs is one of the most important items in the annual expenses incident to the operation of street railways, and as all classes of roads have been in operation a sufficient time to enable them to form a fair estimate of this class of expense, provided they have taken care to separate this item in their accounting, it would seem that we can now take up this subject and treat it in an intelligent manner. From the reports received from various classes of roads, we find that in general four divisions are made as follows:

Line Repairs.
Track Repairs.
Car Repairs, and Motor Repairs.

In numerous instances we find only two divisions, classified as "Line and Track Repairs" and "Car Repairs." There should be, strictly speaking, a fifth class added, namely, station repairs; this latter, however, we find in many instances has been charged off to the general item, maintenance of motive power. It seems to us that too careful subdivision and classification of the operating expenses cannot be made if economy of operation is to be consulted, for if only general divisions are made, it becomes practically impossible to determine just where the heavy item of expense comes in, and what action is necessary to reduce these outlays to the lowest possible point. As an instance of the variation in the items of repairs, we find a large road, operating something over a hundred cars, reports cost of repairs per car mile as follows:

Repairs on Motor and Gearing	.00918
Repairs on Car Bodies and Trucks	.00442

The road bed in this case consisting of a sixty-six pound girder rail, granite paved street; length of tracks forty miles, steepest grade 5 per cent., though the general character of the road is level. Another road operating about twenty cars makes a division as follows:

Repairs on Engines and Boilers	.00110
Repairs on Dynamos	.00013
Miscellaneous Repairs on Power Plant	.00236
Repairs on Motors	.00166
Repairs on Gearing and Trolleys	.00552
Repairs on Car Bodies and Trucks	.00110

Making a total for repairs of Power Plant of .0036, and on rolling stock .0083.

Maintenance of road bed and track	.0067
Maintenance of line	.0015

To this may be added a separate item, which this particular road classified under transportation expenses, it being cleaning and inspecting cars, oil, waste, etc., at a cost of .00287, making a total cost of what may be properly classed under the head of repairs, of .02217 as the cost of this item per car mile. This is certainly very small. The road bed consisted of T-rail varying from twenty-five to fifty-six pounds, and girder rail varying from thirty-five to sixty-three pounds, the total length of track being six miles paved and ten miles unpaved; the steepest grade at any one point was 9 per cent. for a short distance, while the general character of the road was moderately heavy. This particular road was a comparatively new one, having been in operation about one and a half years when this report was made up, but we lay, in a large measure, the small cost of repairs to the excellent system of inspection which was faithfully carried out on the road. The cars were inspected carefully at the end of each day, two men going over every detail of the car, including motor and truck, brake mechanism, etc., and spent about twenty minutes to half an hour on each car wiping up excess of grease and giving the motors a brief cleaning, seeing that the bearings, brushes, etc., were in good condition for the following day's run and that no nuts were loose or cotter pins gone, and once a month the armatures were removed from the cars entirely and all parts of the motor thoroughly cleaned, the bearings overhauled, and replaced if much worn, armature and fields repainted and any little repairs made that were necessary to get the armature, fields and cables, etc. into first-class condition. The result has been that, although this road has been in operation now some two years and a half, their item of repairs has not materially increased, although they have found one or two points where a slight increase has been noticed; these points being in the track and line almost entirely; they finding that the light rails laid in the first place are not suited for the operation of electric cars and they are now relaying the tracks, as rapidly as the old rails give out, with sixty-three pound girder rails throughout. If we consider the showing made on these two roads on the two classes of repairs on which each gives data, it will be seen that the larger road, which ought to show, all things being considered, a less operating expense for repairs than the smaller one, shows just exactly the reverse. The repairs on the larger road being in the proportion of 136 to 83 for the smaller one; though in addition to its larger number of cars in operation and larger mileage, it had, to start with, a much better road bed than the smaller road. As it is well known that a good road bed is a material aid in lessening the cost of repairs on motors, car bodies and trucks, the reason for this poor showing is not far to seek and can be summed up in a few words—lack of inspection. Cars which are not overhauled until something gives out, as a natural result, instead of costing comparatively a small amount to repair, cause this item to often assume relatively large proportions. If managers and superintendents of roads would only stop to think on this subject a moment, they would readily see that if the apparatus needing repair is taken in hand upon first symptoms of trouble, the deterioration could be checked and the apparatus put into good repair at a very small expense, while, if allowed to run until necessity compelled them to take action, the deterioration would probably have gone so far as to cost a considerable sum to again place the apparatus in good condition. The only way in which it can be ascertained that the apparatus is in need of slight attention, is by a careful system of inspection regularly followed out; such a system was very fully presented in an article entitled "The Care of Motors for Electric Street Railways," published in the issue of the "Electrical World," dated August 5th, 1893; a summary of which is that for the car and its equipment there should be three kinds of inspection; one at the end of each trip, which is of the briefest kind, and in a general sense to see that the motors are in good running condition.

Second, The daily inspection, which is made after the car is run into the car barn at night; it being a more thorough inspection and general cleaning up of the motor and replacing of any minor missing parts and making minor repairs such as may be necessary to put the car in good condition for the following day's service.

Third, A monthly inspection of each car, in which the motors are taken apart, thoroughly overhauled, cleaned and repaired. It is, of course, to be understood that should any serious defect be found at any one of these inspections, the car will be put out of service and repairs made immediately. If, on the daily inspection, about half an hour be allowed to each car, it would be seen that in the course of a night an inspector could handle from fifteen to eighteen cars without very much difficulty, and on a pinch could look after twenty cars. With the inspector should be a laborer, who should go over the motors and clean them at the same time that the inspector is going over them. Such a system as this, if carried out, will do much to keep the cars in good running order and save very materially in the repair bill. In fact, the saving is much more than people are apt to suppose, and the wages paid this inspection and cleaning force is directly in the line of the best economy.

The aim of the large manufacturers of electrical apparatus of the present day is to make the apparatus so perfect that there will be very little danger of its getting out of order and so simple in its construction that should it get out of order repairs can be made by the street railway people themselves. I have heard quite a number of street railway men make the statement that such and such a company must make lots of money off of their repair work. This idea is erroneous; the large companies do not want the repair work, because they cannot do the work at a profit and it interferes seriously oftentimes with their regular work, which is the manufacture of apparatus. Therefore, I think I may safely say that the large companies would prefer each road to do their own repair work. Such being the case, the question arises as to whether it is cheaper for a road to return armatures, fields, commutators, etc., to the factories for repairs or do the work themselves. If a road is operating six or more cars, it would seem, from all the information I have been able to obtain on this subject, that it would be more economical for a road to do its own repairing, and in the case of large roads operating many cars, there can be no question but what a very material saving in both time and money can be made by their doing this. Assuming that a road has decided to do its own repairing, provision should be made so that this work can be carried on thoroughly and expeditiously; room should be set apart for this purpose, and none other, and should be properly fitted with the necessary tools required in the work, and particularly, there should be a lathe of suitable size for handling the armatures so that commutators may be turned down, bands put on, etc. For this purpose a good gap lathe seems to be about as useful as any and takes up less room and is not as expensive as is the more complicated machine lathe. Winding stands should be provided for the arma-

tures; these could be made up at very slight expense by making a very rough pattern of stand and providing it with two rollers in the top so that the shaft of the armature can rest on the rolls and thus be free to turn in either direction needed for winding purposes. Adjacent to the repair room should be the stock room, where should be kept a full supply of all materials necessary for making ordinary repairs, and it is always a good plan to keep a few commutators, brush holders and yokes on hand so that in case trouble occurs time will not be wasted in sending to the factory for these articles, and if armatures are wound with made up coils, a reasonable supply of these should be carried in stock at all times. These latter should be obtained from the manufacturers of the machine in question as they can undoubtedly furnish these better and cheaper than they can be made up by the roads themselves.

As many of the repairs to truck and motors will be made over the pit, attention should be paid to this latter particularly. I will venture to say that nine roads out of ten have a pit which is simply a long rectangular tank of the width of the track, and five to six feet in depth, with little or no attention paid to ventilation or heating, and but little more to lighting. If the managers and superintendents of roads would go down in those pits and lay on their backs and try to do work on a cold winter's day they would realize that a man would have to be a saint in order not to make the air blue with profanity for having to work in such a place. It certainly would cost very little more to carry the pit out on the floor for a couple of feet each side, deepen it to seven feet and place a narrow platform along the center about half the depth of the pit so that motors could be dropped down on this platform and overhauled there rather than dropping them into the old style pit and have to hoist them up on the floor above and handle them over half a dozen times. The time wasted in this latter method would, in the course of a month, pay for a decent pit. Provision should be made by means of steam pipes for heating the pit to a fair degree of warmth so that the men can work in comfort while there, and also ample provision should be made for thoroughly lighting the pit, not in the way most pits are, with about two incandescent lamps of questionable candle power attached to the end of a long piece of flexible cord which the men can take around with them to get light on the particular spot actually needed, but in the place of such an arrangement, light the pit up thoroughly so that the men can see to do work in all parts of it. Then in addition to this put in two 32-candle power lights with flexible cords and protected with wire screens for the men to handle around in bringing more light on to any one particular point. A little attention paid to small matters like these which enhance the comfort of the men, does more to make them contented and secures a better return for money spent in wages than almost anything else that has ever been tried.

There is one point that seems to be neglected by almost every street railway in connection with provision being made for repairs, and that is providing proper means for quickly mounting and dismounting the car bodies on the trucks. Motors are liable to be damaged while in service and a car run in at any time, needing more or less repairs, and it oftentimes happens that these are of such a nature as to necessitate the removal of the truck from the car body. A very simple means of effecting this removal is to provide a heavy wooden horse that can be placed under one end of the car body and provide a rope sling for the other end, in the upper end of which is placed the hook of a lower block of a heavy double purchase, the upper block of which is secured to a heavy cross beam overhead; then lead the running part of the falls through a snatch block on the floor and thence to the winch of a motor hoist, or, as illustrated in one of the papers some little time ago, make it pass to the cross bar of a car on the track and then by starting the motor or the car the car body is easily started clear of the truck, and when the truck is run out clear, another truck may be put in its place or the car body dropped on a second heavy wooden horse pending the return of its own truck.

REPAIRS OF STATION.

As previously mentioned, the repairs that occur in the power station should be kept distinct from repairs of cars, and as a rule roads do this, because the power station is distinct and separate from the car barn, but even in case the power station and car barn are in the same building, inasmuch as we are anxious to operate roads as economically as possible, and, therefore, to lessen the repair bills, the division should be made distinctly so that bad leaks can be discovered at once and proper remedies taken to prevent their further continuance. As far as possible roads should have a man for the chief engineer of their power station who has a good fair knowledge of dynamo electric machinery as well as a knowledge of steam engines, and he will then be able to act in an intelligent manner in case any trouble occurs and not go flying out the door of a station when he happens to see a ring of fire go around the commutator of the dynamo as I have known to happen on more than one occasion. The generator is, although often a ponderous affair, still a more or less delicate piece of mechanism, and should receive careful attention and a thorough cleaning and overhauling after a day's run, and every effort should be made to keep the generators clear from dirt and oil. After a machine is shut down it is always a good plan to take a good sized hand-bellows and blow the carbon dust out from the commutator leads and off the head of the armature. The modern armature for railway purposes is built of made up coils placed in slots in the armature and held in place by wooden wedges so that in case one or more coils should be burned out repairs can be made by the regular men in the station, provided they have some of the made up coils on hand as should be the case. For the large direct driven generators there can be no question but what the repairs must and should be made in the station, and under no consideration should the armatures be returned to the manufacturer. If an accident occurs to one of these armatures and it is felt that your armature winder is not competent to tackle the job of repairing it, then send to the manufacturer for a man to go to the station and do the work there as this will be materially cheaper than attempting to send one of these large armatures back to the factory, but it should be distinctly understood that the road requiring one or more of such large generators to operate it should have a competent armature winder among its force who could make any and all repairs to armature and fields of both generators and motors.

It is almost unnecessary to call attention to the necessity of keeping the engines in good condition so far as cleanliness is concerned, because it is a well known fact that a stationary engineer, if he is any good at all, takes pride in his engine and looks after it carefully, but as these are liable to get out of order in certain parts, it should be laid down as one of the most rigid rules, that indicator cards should be taken of each and every engine at least once a week, and should cards indicate a displacement of the valves, causing wrong working of the engine or loss of power, immediate steps should be taken to rectify this and not let the trouble continue until it becomes an actual necessity to make the changes or repairs.

The boilers being one of the most vital parts of the system, should receive the most careful attention and a thorough system of cleaning and inspecting should be adopted, for right here comes in one of the most important things in the economy of the whole system and that is the necessity of securing competent firemen. The importance of this cannot be urged too strongly on the attention of managers of street railways, for on this point may occur one of the most serious losses in the whole system; here, if anywhere, should pains be taken to secure the very best men that can be found in the market. It is the best of economy to pay a first-class fireman $2.50 per day or even more, but be sure that you get a first-class one. In the matter of pay of a fireman, I know of quite a number of instances where companies have paid first-class men $2 per day and a certain percentage on the value of coal they save over a certain amount which was deemed a fair average for running the boilers to produce the steam required. In every case this method has worked exceedingly well and has resulted in a material saving of coal in every instance, and I should strongly advise every road to follow out some such system as this, for it is easily seen if a man's pay depends not on how much coal he can throw in the furnace, but on how much he saves, he will look very sharply after his fires and will take an interest in the plant that he otherwise would not. The feed pumps, condenser and circulating pumps, together with the steam piping, should be carefully gone over at stated intervals by the chief engineer of the power house in person, and given a thorough examination to see that they are working in a proper manner, and in case leaks are discovered at any time, they should receive prompt and immediate attention, as any delay in this is liable to lead to very rapid deterioration. Very few men stop to think when they see a leaky steam pipe that such leaks represent a direct loss in horse power; they think it doesn't look very well but that is about all the attention they give it. If they would, instead of looking at it that way, only consider for a moment how much coal it takes to turn water into the amount of steam they see coming from such a leak, and recollect that every pound of coal costs money, they would see that such leaks mean a loss in dollars and cents and nothing else; and if a manager, looking at the matter in this light, should go into his power station and see such things going on, I venture to say that leaks would be stopped very quickly.

LINE REPAIRS.

I think it will be safe to assert that more than one-half the roads

in this country have no system of inspection for their lines and no repairs are made thereto until something goes down and a few dollars are lost, varying in amount, depending on how serious the damage is when the break occurs, before any attempt is made to repair the line. Suppose we pause for a moment and consider what the line represents, to what service it is subjected, and then let us see if this is not one of the most vital points in the system that needs attention. Lines that have been put up in recent years have usually been of number 0 copper, supported at intervals of about 125 feet by insulators depending from span wires or bracket arms and having attached to the insulated bolt an ear soldered hard and fast to the trolley line. This line is then hauled as taut as possible and kept in place by means of strain insulators. At every point of suspension the line is elevated a little more than elsewhere, so that when the trolley goes along at a fair rate of speed it strikes the trolley wire at the end of the ear a blow, and if the line sags down much, this blow is often quite a severe one, and as the trolley goes along under the wires it forces it up, thus bending it a little every time at the point where the ear is joined on to it. From this two dangers may arise; first, the insulation may be cracked from repeated blows, and second, the trolley wire itself may be crystallized and a crack developed in it at the point of suspension. If a crack occurs in the insulator then moisture gets in, rapid disintegration occurs until it no longer acts as an insulator, but dead grounds the trolley to the span wire. This latter may be insulated from a pole, but often is not and on a rainy day will occur a leak which, while not very great at any one point, may amount to considerable on several miles of line. To avoid these casualties a system of inspection of the line should be followed out, which should include a testing for insulation and a going over the line with a tower wagon at stated intervals for the purpose of making a critical examination of the lines in person. Every road, we may assume, is provided with some kind of a tower wagon. There are many kinds in the market, but many of them are extremely cumbersome and make more noise than a Calithumpian band as they go along the street. The neatest tower wagon that I have ever had the pleasure of seeing was one that was shown me on a recent trip I took down East. This was designed by the general manager of the Portland Street Railway, and occupies no more space than an ordinary two-horse team, while the tower part itself lowers down into the wagon body by means of several pieces of timber joined together like a pair of scissors, and is raised up very easily and quickly by means of an ordinary winch handle geared about 3½ to 1. The tower wagon being essentially an emergency wagon, similar to a police patrol wagon in a large city, should be built with the end always in view that when it is wanted it is wanted in a hurry and it cannot get to the spot too fast; for that reason men should always be detailed ready to go on it at any moment, and horses should be kept in readiness for this service alone if the road is a large one. On the wagon should be carried two boxes, one containing the necessary tools to make the repairs, and the other the materials with which to make the repairs except that the coils of wire may be slung underneath the wagon.

TRACK REPAIRS.

The track is another portion of the system which often receives scant attention and very few roads have any regular system of track inspection to see that it is in proper condition. We note that the long experience of steam roads has shown them the absolute necessity of having their tracks in perfect condition at all times, and they have found it a matter of economy to employ track walkers to go over the tracks at stated intervals to make a careful and thorough inspection of every joint, rail, tie and spike. Except in large cities where there is a great amount of traffic, it is hardly necessary to adopt such a very rigid course as this, and the wear and tear of the track is not such as to require it, but it would be economy to have a man go over the track about once in two weeks and examine each joint, noticing particularly how much more motion there is in a joint when a car goes over it; there should of course be just as little as possible, and if the track inspector notices any movement he should make a record of this particular joint and the track gang should attend to it at once, as this is the vital point in the life of the rail, and if the movement is allowed to continue for any length of time the joint becomes battered and the damage to the rail increases very rapidly. One good plan to avoid this tendency to give way at the joint is, in laying the rails to place underneath the joint a plate of ½ inch iron which serves to prevent the rail biting into the tie; then rock ballast the ties at the joints and keep them well tamped up to place, where the rails are spiked directly on to the ties. In case stringers are used, they can be cut away at the joints sufficiently to allow the iron plate to be placed under the rails, and then if attention be paid to keeping the stringers well lined up, the motion at the joint will be sm . A good many that objected to the use of iron plates, stated that it causes a more rapid running of a tie or stringer, but from the best opinions that I have been able to gather, I do not find this to be so, in fact, just the reverse, for the biting process due to the ends of the rails resting directly on the ties or stringers is more destructive than the rotting incident to the use of the iron plate, and it is certain that the iron plate makes a bed for the end of the rail which eventually prevents any great movement of the joint. There is one other point in the track repairs that is beginning to call for special attention, and that is, the maintenance of the rail bond. We find that where there is much movement of the joint the rail bond is rapidly worn out, due to the sawing motion which the rail exerts on the bond as it rises and falls. Therefore, to avoid this, it is necessary to go back far enough away from the joint so that no perceptible motion will be felt. In other words, to avoid this difficulty, we should bond our rails back 2½ or 3 feet from the joint; this of course means more copper at first and a greater cost, but if the rail is properly bonded in the first place and attention paid to this point and the use of double bonds of sufficient size, it would seem as though we need not apprehend much trouble from this source. I ran across a road a little while ago which avoided the bonding question entirely, practically speaking, by depending on their fish plates, supplemented by a copper washer under the bolt heads for the transmission of their current by the rails. I endeavored to convince the superintendent that this was not the proper method, but I regret to say my powers of argument were not sufficient to overcome his tenacious ideas on the subject; therefore, he will have to learn the lesson by experience, the same as others have done, that a proper bonding of the track in the first place, with careful attention to it afterwards, and the maintenance of the track and road bed in good repair, are two of the greatest economies that can be practiced in the operation of a street railway system.

In conclusion, I would state, that the whole sense of this article can be summed up in the few words of an old adage, "A stitch in time saves nine."

Electricity and Whiskey.

A correspondent of London "Lightning" asks how to apply an electric current to the purification of well water, the objection to this water being that it turns whiskey black. The editor of that journal remarks that the writer has by no means proved that the water is at fault and suggests that he look to his whiskey as well, as poor sorts of whiskey may contain sulphuretted hydrogen or tannin, which blacken iron salts. If the electrical treatment should prove to be too expensive, he recommends the American method of consuming the whiskey and water separately, and adds that he need not fear that the black compound will form in his own well, as the presence of the gastric juice will prevent the formation of any black iron sulphide.

Cost of Electric Traction.

From a discussion of a paper read in London, it appears that the cost of power and traction on the Marseilles electric line, which has gradients as high as one in sixteen, is a little over 6 cents per train mile, coal costing $5 per ton; at Florence with continuous grades up to 1 in 20 and 1 in 12.5, it is 8 cents, coal costing $7.50 per ton; at Budapest and other lines in Europe, 8 cents covers the entire working expenses; on the Liverpool line the total working expenses are 27 cents per train mile, which is 86 per cent. of the receipts.

Compressed Air Traction.

A reservoir recently burst in one of the cars of a compressed air line in the streets of Paris, but the passengers escaped uninjured. One of the many advantages of electricity over compressed air traction is that electricity does not burst, and passengers on trolley cars need therefore not be in constant fear that there is something like a dynamite bomb directly under the seat on which they are sitting.

Lowering the Candle-power of Lamps.

The idea of switching two lamps in series when a dim light is required, such as a bedroom night light, has been reinvented many times. Our bright contemporary, London "Lightning," in referring to this, remarks that there is touch of humor in Messrs. Rawlings' device of putting one lamp out of sight to satisfy a public that "cannot understand why two lamps should be used when one is more than they want."

Electrodynamic Machinery—XII.

BY E. J. HOUSTON AND A. E. KENNELLY.

55. It is important to remember that the entire conception of metallic reluctivity is artificial; although very convenient for purposes of computation, yet, as already pointed out, it is incompetent to deal with the case of residual magnetism. Thus, if the prime M. M. F. in the ring be withdrawn, we should expect the flux to entirely disappear, whereas we know that a large proportion will generally remain. Since, however, electro-dynamic machinery rarely calls residual magnetism into account, the reluctivity theory is adequate for practical purposes beyond critical magnetizing forces.

56. As another illustration, let us consider a very long rod of iron, wound with a uniform helix. Here, as we have already seen, disregarding small portions near the extremities, the intensity may be regarded as uniform within the helix. Since the reluctance of the external circuit may be neglected, this flux density, as we have seen, is 1.257 n i, gausses, where n, is the number of loops in the helix per centimetre of length, and i, is the exciting current strength in amperes. Or, regarding the intensity as the gradient of magnetic potential, which changes steadily by 1.257 n i, per centimetre (this

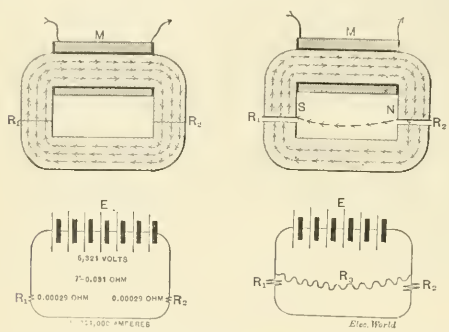


Fig. 48 and 49.—Diagrams Representing a Simple Ferric, and an Aero Ferric, Circuit, and their Electric Analogues.

being the number of gilberts added in the circuit per centimetre of length), the fall of potential or drop in the external circuit being negligible, the gradient within the helix is 1.257 n i gausses as before. A rod of Norway iron one meter long and 2 cms in diameter, wound with 20 turns of wire to the centimetre, carrying a current of one ampere, would, at this magnetizing force, have an intensity in it of approximatly 1.257 × 20 × 1 = 25.14 gausses. The reluctivity of Norway iron would be by the preceding formula $\nu = 0.0004 + 0.000057 \times 25.14 = 0.001,833$ or about 1-500th of air. The length of rod being 100 cms, and its cross section 3.1416 square cms, the reluctance would be approximtaely $\frac{100}{3.1416} \times 0.001,833 = 0.05836$ oersted. The total M. M. F. being 100 × 20 × 1 = 2,000 ampere-turns = 2,514 gilberts. The flux in the circuit, assuming that the reluctance of the air path outside the bar may be neglected, is approximately $\frac{2,514}{0.05836} = 43,070$ webers, with an intensity of $\frac{43,070}{3.1416} = 13,710$ gausses.

57. In cases where the flux is confined to definite paths, as in a closed circular coil, and in a very long straight and uniformly wrapped bar, the preceding calculations are strictly applicable. When, however, an air-gap is introduced into the closed ring, that is, when its circuit becomes aero-ferric, the results begin to be vitiated, partly owing to the influence of diffusion, and partly owing to the results of the counter M. M. F. which is established at the air gap. As the length of the air-gap increases, the degree of accuracy which can be attained by the application of the formula diminishes, but in dynamos, the aero-ferric circuits are in almost all cases of such a character, that the degree of approximation, which can be reached by these computations, is sufficient for practical purposes; for, while it is impossible strictly to compute the magnetic circuit of a dynamo by any means within our present reach, yet the E. M. F. of dynamos, and the speed of motors, can be predicted by computation within the limits of commercial requirements.

58. If the ring of Fig. 45 be provided with a small air gap of 0.5 cm in width, the intensity in the circuit before the introduction of the iron core will be practically unchanged by the existence of the gap, that is to say, with the same 1,000 ampere-turns, or 1,257 gilberts of M. M. F., the intensity existing in the ring will be practically 20.95 gausses. In the air-gap itself, the intensity will be less than this, owing to lateral diffusion of the flux; and, neglecting these influences, we may consider the intensity to be uniform. Now, introducing a soft, Norway iron core into the same air gap, the iron is subjected to an intensity of approximately 20.95 gausses throughout the circuit. The reluctivity of the iron at this intensity, is, as we have seen, 0.001,596. The length of the circuit in the iron will be 59.5 cms., and its cross section 10 sq. cms, making the ferric reluctance $\frac{59.5}{10} \times 0.001594 = 0.009,484$ oersted. The reluctance of the air-gap, neglecting the influence of lateral diffusion, will be $\frac{0.5}{10} \times 1 = 0.05$ oersted, and the total reluctance of the circuit will, therefore, be 0.009484 + 0.05 = 0.059484 oersted. The flux in the circuit will, therefore, be $\frac{1,257}{0.059484} = 21,130$ webers, and the intensity in the iron 2,113 gausses. The existence of the air-gap has, therefore, reduced the flux from 131 kilowebers to 21 kilowebers.

59. In practical cases, however, the problem which presents itself is not to determine the amount of flux produced in a magnetic circuit under a given magnetizing force, but rather to ascertain the M. M. F., which must be impressed on a circuit in order to obtain a given magnetic flux. When the total required flux in a cicruit is assigned, the mean intensity of flux in all portions of the circuit is approximately determinable, being simply the flux divided by the cross section of the circuit from point to point. What is required, therefore, is the reluctivity of iron at an assigned flux density and this we now proceed to determine.

From the equations $S\,\nu = a + b\,\mathcal{H}$, and $\mathcal{B} = \frac{\mathcal{H}}{\nu}$, corresponding in a magnetic circuit to $i = \frac{e}{\rho}$ in the electric circuit, i, being the electric flux density or amperes per sq. cm. and ρ, the resistivity, we obtain, $\nu = \frac{a}{1 - b\,\mathcal{B}}$

This equation gives the reluctivity of any magnetic metal for any value of the flux density $\mathcal{B}$, passing through it, when the value of the constants a, and b, have been experimentally determined. The values of ν, so obtained are only true for reluctivities beyond the critical value where the linear relation expressed in the equation $\nu = a + b\,\mathcal{H}$ commences.

60. Fig. 47 shows curves of reluctivity of various samples of iron and steel at different flux densities. The descending branches are of practically little importance in dynamo electric machinery. They are included in the curves, however, in order to bring them into coincidence with actual observations. It will be seen that while the reluctivity of Norway iron is only 0.0005 at 8 kilogausses, that of cast iron is commonly about 0.010, or twenty times as great.

61. In order to show the application of the above curves of reluctivity we will take the simplest case of ferric circuit; namely, that of a soft Norway iron anchor ring, as shown in Fig. 44, of 10 square centimetres cross section and 60 cms mean circumference, uniformly wrapped with an insulated wire coil. If it be required to produce a total flux of 180 kilowebers in this circuit, the intensity in the iron will be 8 kilogausses, and, by following the curve for Norway iron, in Fig. 47, it will be seen that its reluctivity at this density is 0.0005. The reluctance of the circuit, therefore, will be $\frac{60}{10} \times 0.0005 = 0.003$ oersteds, and the M. M. F. necessary to produce the requisite magnetic flux will be $\mathcal{F} = \phi\,\mathcal{R} = 80,000 \times 0.003 =$ 240 gilberts, or 240 × 0.7958 = 191 ampere turns.

62. If, however, the ring be of cast, instead of soft Norway, iron, its reluctivity at this density would be say 0.010, and its reluctance $\frac{60}{10} \times 0.010 = 0.06$ from which the required M. M. F. will be 80,000 × 0 06 = 4,800 gilberts = 3,820 ampere turns. The importance of employing soft iron for ferric magnetic circuits, in which a large total flux is required, will, therefore, be evident.

63. Fig. 48 is a representation of a simple ferric circuit consisting of two closely fitting iron cores, the upper of which is wrapped with a magnetizing coil M. The polar surfaces are made to correspond so closely, that when the coil M has a magnetizing current sent through it, the magnetic attraction between the two cores will cause them to exclude all sensible air gaps. The general direction of the flux paths is shown by the dotted arrows, and a mechanical stress is exerted within the iron along the flux paths.

These stresses cannot be rendered manifest, so long as the iron is

continuous. In other words, the continuous anchor ring, as shown in Fig. 44, would give no evidence of the existence of stress along its flux paths. In the case shown in Fig. 48 the stress is rendered evident by the force which must be applied to the two magnetized cores in order to separate them. The amount of this force depends upon the magnetic intensity in the iron at the polar surfaces, and, if , represents this intensity, the attractive force exerted along the flux-paths at the polar surfaces, *i. e.*, perpendicularly across them, will be $\frac{\quad^2}{8\,\pi}$ dynes per square centimetre of polar surface. The dyne is the fundamental unit of force employed in the system of units universally employed in the scientific world, and is equal to the weight of 1.0203 milligrammes at Washington; that is to say, the attractive force which the earth exerts upon one milligramme of matter is approximately equal to one dyne.

64. If the magnetic circuit shown in Fig. 48 has a uniform area of cross section of 12 square centimetres, and the magnetic intensity in the circuit be everywhere 17 kilogausses, then the attractive force exerted across each square centimetre of the polar surfaces at R_1, and R_2, will be

$$\frac{17{,}000 \times 17{,}000}{8 \times 3.1416} = 11{,}500{,}000 \text{ dynes.}$$

or $11{,}500{,}000 \times 1.0203 = 11{,}730{,}000$ milligrammes weight $= 11{,}730$ grammes weight $= 25.86$ lbs. weight.

As there are twelve square centimeters in each polar surface, the total pull across each gap will be $12 \times 25.86 = 310.32$ lbs. weight; and since there are two gaps, the total pull between the iron cores will be 620.64 lbs. weight, so that, if the whole magnet were suspended in the position shown in Fig. 48, this weight should be required to be suspended from the lower core (less, of course, the weight of the lower core) in order to effect a separation; or, in other words, this should be the maximum weight which the magnet could support.

65. In order to ascertain the M. M. F. required to produce the required intensity of 17 kilogausses through the circuit to cause this attraction, we find, by reference to Fig. 47, that the reluctivity of Norway iron at this intensity is 0.0073; *i. e.*, $\frac{73}{10{,}000}$ that of air. The reluctance of the magnetic circuit will, therefore, be $\frac{50}{12} \times 0.0073 =$ 0.03042 oersted. The total flux through the circuit will be 17,000 $\times\ 12 = 204{,}000$ webers, and the M. M. F. required to produce the flux, therefore, will be $204{,}000 \times 0.03042 = 6{,}206$ gilberts, or $6{,}206 \times 0.7958 = 4{,}937$ ampere turns. If, then, the coil M, has 2,000 turns, it will be necessary to send through it a current of 2.469 amperes, in order to produce the flux required.

The electric circuit analogue of this case is represented in the same figure, where E represents the E. M. F. in the electric circuit as a voltaic battery, and the amount of this E. M. F. necessary to produce a current of strength *i*, amperes when the total resistance of the circuit is *r*, ohms will be $E = ir$ volts.

66. So far we have considered that no sensible reluctance existed at the polar surfaces R_1, and R_2. Practically, however, it is found that, no matter how smooth the surfaces may be, and, therefore, how closely they may be brought into contact, a small reluctance does exist, owing, apparently, to the absence of molecular continuity.

This reluctance has been found experimentally, in case of very small joints, to be equivalent to the reluctance of an air gap, from 0.003 to 0.004 cm wide (0.0012″ to 0.0016″.) Taking this reluctance into account we have at R_1, and at R_2, an equivalent reluctance of air path, say 0.0035 long and 12 cms in cross sectional area. Since the reluctivity of air is unity, the reluctance at each gap becomes $\frac{0.0035}{12} \times 1 = 0.00029$ oersted, and the reluctance of the circuit has, therefore, to be increased by 0.00058 oersted, making a total of $0.03042 + 0.00058 = 0.031$ oersted, and requiring the M. M. F. of $204{,}000 \times 0.031$ of 6,324 gilberts $= 5{,}032$ ampere turns, or an increase of current to 2.516 amperes.

(To be continued).

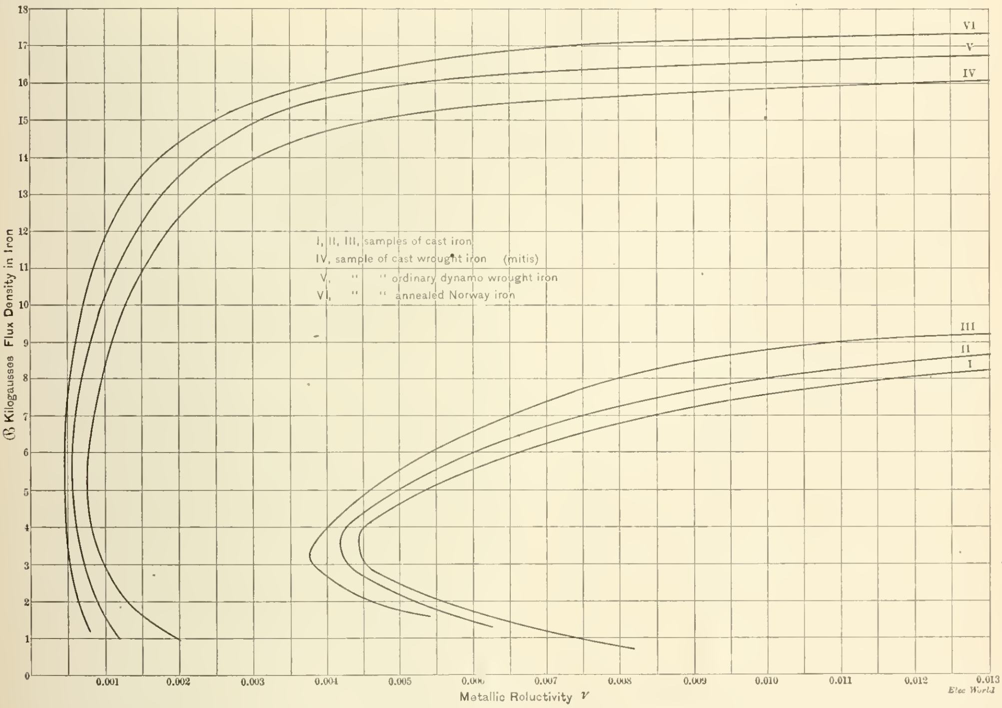


FIG. 47.—CURVES OF METALLIC RELUCTIVITY IN IRON IN RELATION TO FLUX DENSITY, FROM OBSERVATIONS BY ONE OF THE WRITERS ORDINATES, RELUCTIVITY, r; ABSCISSAS, FLUX DENSITY ℬ.

An Expensive Joke.

The exhibitor of an "Electric orchestra" in a city in Germany, connected one of the chairs of the audience with an electric circuit in such a way that any one sitting down on it immediately rose again with a jump, much to the amusement of the audience. One of the audience, however, who did not appreciate the joke, took the matter to court and was awarded $75 damages.

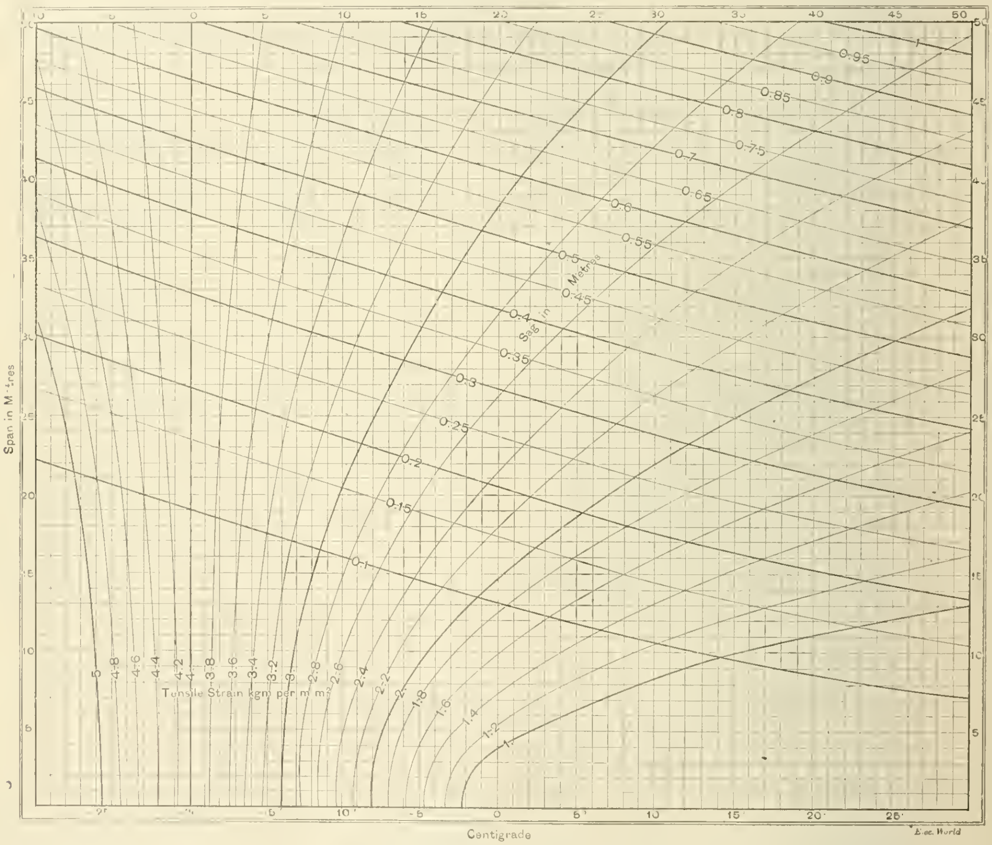
The Sag of Copper Lines.

In a paper "On the Sag of Soft Copper Wires Freely Suspended," of which we have received proof sheets, Mr. Josef Herzog, of Budapest, makes an elaborate study of the subject with particular reference to copper wire.

The condition laid down is that the wire should be strained only so far that with a decrease of temperature there will occur no stresses which, when the temperature again increases, would lead to abnormal sagging. From the various equations deduced, curves were plotted by means of which the sag may be determined for any case. In the figure below, which we reproduce from Mr. Herzog's paper, the horizontal lines correspond to the length of span in metres and the vertical lines to temperature in degrees centigrade. The curves starting from the bottom represent the tension in kilogrammes per mm², and the intersecting curves the sag in metres.

As an example of the application of the curves, suppose we wish to know the most desirable sag of a wire with a span of 40 metres and at a temperature of —12 C. It will be seen that the intersection of the 40 metre horizontal line and the —12° vertical line falls very near to both the 0.5 metre sag curve and the 3.6 kilogramme tension curve. The sag at —12°C will therefore be 0.5 metres and the tensile strain 3.6 kilogramme per mm². At a temperature of 30°C, we similarly find that the sag of the same line would be about .78 metres and the tensile strain 2.3 kilogrammes per mm².

By these curves, therefore, the sag and tensile strain for any temperature may be determined. The author states that the latter should not exceed 4 kgm per mm².



SAG AND TENSION OF COPPER LINES.

White Reflectors.

According to London "Electricity" a perfect dead white reflector of one square foot, illuminated with π candle foot emits one candle-power normally.

The Worcester Polytechnic Institute.

The Worcester Polytechnic Institute begins its work this year under promising conditions. The electrical classes in particular, both graduate and under-graduate, are larger than ever before in the history of the school. Dr. T. C. Mendenhall, who last summer resigned his position as Superintendent of the U. S. Coast survey and accepted the presidency of the Institute, has just returned from Europe and will enter upon his work at once. The Worcester school is to be congratulated upon having secured for its leader one who is so well known as an able administrative officer and as a distinguished scientific scholar. Instruction in electrical engineering at the Worcester Institute is given during junior and senior years, and an advanced course of study and work for graduates is also provided. The laboratory has for experimental work fifteen dynamos and motors of various types, including a complete A. C. station outfit, with transformers and lamp load for 500 lights. It is wired for the 50-volt A. C. current, also for the 500-volt current from the power circuit of the Worcester Electric Light & Power Company. It has a storage battery of 250 20-ampere hour cells and a variety of single cells for special uses. It is also well furnished with instruments for standard and commercial measurements. Five rooms in the Salisbury Laboratories, with an aggregate floor space of 7,000 square feet, are used for electrical work, in addition to lecture rooms and an isolated stone building for work requiring special accuracy. An important feature in this course is the station work, which the courtesy of the directors of the local Electric Light & Power Company has enabled this department to offer. The students, under the direction of an instructor, are allowed to observe the methods and to study in detail the machinery and wiring of the establishment, until each one has had an opportunity to trace and chart the whole installation from the boiler-room to street lines. The electrical engineering department of the Institute is under the direction of Prof. A. S. Kimball.

Fly Wheel Accidents in Power Stations.

To the Editor of The Electrical World:

Sir:—The conditions described in the letter of Mr. Coykendall on fly wheel accidents are unquestionably likely, even certain, to occur occasionally, perhaps frequently. Their existence would as certainly introduce overload and risk, and I think it extremely possible that they may have been the occasion of some of the accidents which have come to be common since the introduction of the electric current for transmission of power.

The breaking of a fly wheel and the consequent wrecking of an engine is not a recent innovation or an accident confined solely to electric power-stations. Numbers of such wrecks have happened in cotton mills and rolling mills, and they may be met with in any engine room in which an engine with detachable valve gear is in operation. Every case that I have known has been the breakdown of machines of that class. Liability to the accident from the causes to which our attention is here called—sudden excess of current at the driven dynamo—is equal with all classes of engine. In such cases, the instantaneous application of abnormal resistance, if the wheel be weak, is liable to throw upon its arms a proportionally excessive load, and the wheel may go to pieces. But, I think, in most cases, the belt would slip before the over strain could reach the danger limit, and where this might not occur, if the wheel were properly proportioned and given a good "factor-of-safety," it would usually carry the load until it reached such a limit that the provision at the dynamo, the circuit breaker or fuse, or some other limit to rising voltage or current, would be affected, and the crisis would be safely passed. The fact that so few such accidents occur with high-speed engines would seem to indicate this to be the case. But a weak wheel, on either class of machine, would be apt to yield to such treatment as your correspondent describes.

In such accidents as I have known, of the class referred to, the engine is found, after the break-down, to have had its governor deranged and, presumably, this has been the cause of the accident. A belt slips or breaks, or the key comes out of the governor pulley, or the engine is relieved so suddenly and completely of its load that the charge of steam just taken into the cylinder is sufficient to accelerate its speed to the danger-point with a weak and faulty wheel. The conditions of operation of the engine in electric light and power stations are peculiarly favorable to the production of such accidents. The enormous variations of power, often from no load to an excessive load, in an instant, and the constant changes of load are sure to result in a constant jerking and shaking of the whole machine, and especially in the governor system. And this rattling of the governor pulley, if the key be not driven hard, and the shaking of its belt, make it certain that, sooner or later, something will get loose. If it shakes out the key, the result is pretty certain to be disastrous; if the governor belt simply slips, danger follows, if not disaster; if the belt breaks, the engine is gone.

Another seldom-noted danger is that resulting from the fact that many governors are not so designed and built as to be capable of acting effectively, in these cases of exceptionally rapid rise in speed of rotation. Mr. Porter discovered, proved, and promptly published the fact, many years ago. He found that the sudden jerk of the governor, in such instances, might cause the arms to bind on their pins, or in their sockets, in such manner as to render them nearly or quite inoperative, and thus to introduce the superlatively dangerous condition of a governor working satisfactorily on all ordinary occasions, and awakening no suspicion, and finally, when its services are most needed to prevent a possibly destructive and fatal accident, refusing to work at all. He introduced his loaded governor, with widely separated pivot-points at the extremities of the arms, to evade this serious risk.

Every drop-cut-off engine, on such duty—in fact, I am inclined to say, every engine with detachable valve-gear, without regard to kind of duty—should have some automatic system of detachment, at a stated limit of speed in excess of the normal, and this "knock-off" is, I think, now considered an important feature in every plant of this character. With a well-designed, well constructed wheel, free from such flaws as have distinguished some of those which have gone to pieces in late years, and guarded by proper automatic devices at engine and dynamo, the danger of this form of accident becomes, or may be made, insignificant.

The danger, in case of short circuiting of the dynamo, is ordinarily reduced by the fact that, in most cases, the power is transmitted from engine to dynamo through a pulley-fly-wheel, and the tendency is thus always to put a brake upon the wheel in the most effective and safest manner, while the slip of the belt adds security. The only shock, in such a case, comes mainly of the inertia of the reciprocating parts of the engine, and then only when near the half centre. "On the centres," no such shock can occur. Where, however, as in some European practice, particularly, the power is transmitted from a separate driving pulley and the fly wheel is not belted, the danger is greater in consequence of the fact that the surge, with sudden checking due overload, takes effect upon the arms of the fly-wheel in the most trying manner, and irrespective of the position of the working parts, which, in such case, assist by reducing, rather than intensifying, the shock. This latter is also the case of the directly-connected dynamo, now becoming so common an arrangement, and which is found so satisfactory in other respects.

Ithaca, N. Y. R. H. THURSTON.

To the Editor of The Electrical World:

Sir:—From my experience with short circuits, I do not think Mr. Coykendall's explanation is the best one, although it would be a rash man who would say that the wrecking of an engine cannot be caused by a short circuit, either within or outside the power station. Circuit breakers do sometimes stick, and while the generators are invariably protected by fuses in addition to the circuit breakers, the time required to blow the fuse might be sufficient for the overload to wreck the engine. To one statement of the writer I take exception. He says in the third paragraph, "The circuit is thereby broken and the engine unloaded, its speed being thereby accelerated somewhat even with the best of governors and the voltage therefore raised still more." This can hardly occur with a modern engine. Engines as built nowadays will rarely accelerate more than one or two per cent. when the load is thrown off, and with a compound wound generator when the load is thrown off the voltage will drop instead of rising if the speed remains constant, and an acceleration of one or two per cent. would not cause any material rise in the voltage.

My own opinion is, that such accidents are more apt to occur through the governor on the engine becoming inoperative from some one or another of several causes, and a case in which I was personally concerned confirms this opinion.

In a certain power station, two belt-driven railway generators were running in multiple. Without any warning, the circuit breakers went out one after another, almost instantaneously. There was an alarming display of fire works on the switch-board and on the commutator of one of the generators. The engineer at once rushed to the throttle valve of the engine driving the generator which seemed to be in trouble and shut off the steam and also shut down the other engine afterwards. Without examining the switch-board or generator he started up another pair of generators and waited the arrival of the superintendent and myself.

Several of the brush-holder springs on the generator were found burned up. The brush-holders themselves were also badly burned. The commutator looked as though it had been in a fire, and, in a word, the commutator end of the generator looked as near a complete wreck as one could conceive. On the switch-board we found that seven 120-volt incandescent lamps in series had been "blown," showing that the voltage for this machine had risen to 1,000 volts or more. The generator was cleaned up and put in shape again, and a search made for short circuits. We found none inside the station, neither had the trolley wire been on the ground or anything occurred outside, so far as we could learn, to cause a short circuit. The superintendent stood by the engineer who then started the engine. The writer went to the switch-board. As the engine and generator were started, the resistance being all in the shunt field rheostat, the voltage went rapidly to 650, seeing which I called to the engineer to shut down. An examination of the engine showed that a screw in the governor mechanism had come out, so that the governor was inoperative and steam was admitted for fully three-fourths of the entire stroke. There was but one conclusion; that the entire trouble was caused by an acceleration of speed in the engine. Now, if the fly wheel had not been made of good stuff, there would have been a wreck in that station without a doubt. Any little concealed defect in the iron and there would have been another unexplained accident. J. S. BADGER.

Schenectady, N. Y.

To the Editor of The Electrical World:

Sir:—I do not agree with Mr. Coykendall that the prevailing accidents to fly wheels occur principally from sudden impositions of load, as stated in his article. Were such the case many branches of manufacture would be paralyzed with alarming frequency. Automatic cut-off engines have from the first been built in all their parts of sufficient strength to withstand the strains due to the sudden

release and imposition of load, even when the latter is sufficient to slow the engine very perceptibly in a few seconds and in some cases to actually "stall" it. Electrical machinery imposes no more difficult loads on steam engines, so far as safety is concerned, than were previously successfully handled in many branches of manufacture, particularly in rolling mills. I have investigated a number of cases where fly wheels have been disrupted and am satisfied that in those cases, as well as in the majority of others, the accidents were entirely due to centrifugal force arising from high speed, and necessarily involved improper action of the governor. Some wag has said of automatic apparatus, though referring more particularly to safety devices for boilers, that "The better and longer they work the more dangerous they become." Steam engine governors work so perfectly for very long periods that eventually they become neglected in some detail, such as the tightening of the belt or the oiling of the fly wheel type. In such cases the overload in connection with blowing of the fuse or the release of the automatic switch, causes the damage, not on account of the weakness of the engine, but for the reason that full steam is thrown on automatically during the overload, and when such load is suddenly released the engine increases its speed faster than the crippled governor can follow it. If everything has worked well for a long period the engineer is not particularly watchful and a fly wheel disruption results.

At the time Mr. Coykendall refers to, viz.: putting on the load after the circuit has been opened, the engine would be running at speed without load and consequently with short cut-off, so that sudden loading would simply slow it, and besides every one would be on the alert and an accident be hardly possible.

New York, N. Y. CHAS. E. EMERY.

To the Editor of The Electrical World:

Sir:—In regard to Mr. Coykendall's letter on the subject of fly-wheel accidents in electric power houses, I cannot agree with him that the direct cause of wreckage is the undue load thrown on the engine by a short circuit, though this may depend largely on whether the dynamo is on the engine shaft or connected to the fly wheel by a belt.

In the former case the sudden greatly increased resistance in the dynamo tends to check the engine speed suddenly and the stored energy in the fly wheel rim is very apt to wreck the arms first and, of course, the rim afterwards. Where, on the contrary, the dynamo is belt-driven from the fly wheel, if the belt does not succumb to the sudden strain thrown on it, it acts merely as a rim brake on the fly wheel and no harm should occur unless the belt is torn asunder. Should this happen, then the engine is off with a bound and, unless the regulator is very efficient, in a few seconds arrives at a destructive speed for any cast iron fly wheel ever built. An engine of the Corliss type, with a single eccentric and valves adjusted so as to follow to three-eighths stroke, will, unless provided with other device than the ordinary pendulum governor wreck itself every time under these conditions.

I do not believe the wreckage ever occurs from the added cylinder effort to overcome the added resistance, for there is no engine built that it would not be perfectly safe to block at half stroke and then put on full boiler pressure.

Cast iron is not suited to tensile strain and the only reason I can see for builders continuing to use it for fly wheels is that it is cheap. No bridge builder would dare to-day to put a cast iron tension member in a bridge, yet the stress per square inch of section is less in a bridge than it is in the rim of a fly wheel at the very ordinary speed of 5,000 feet per minute.

Manchester, N. H. CHAS. H. MANNING.

To the Editor of The Electrical World:

Sir:—Mr. T. C. Coykendall's comments on fly wheel accidents in Electrical Railway power stations give some conditions of load which may cause bursting of wheels. If the wheels and safety devices are properly designed for the speed and loads that may come the wheels will not burst. The lack of proper design and workmanship seems to be the real cause of such accidents; the former is dependent upon the engineer, the latter upon the manufacturer. In designing an engine for any given case one must first determine the average car load, then the possible ultimate load due to short circuits; make the cylinder dimensions as close to the point of greatest economy at average car load as the condition of maximum car load will allow and design the other parts of the engine for the ultimate load. This applied to the fly wheel problem must take into consideration the possible changes in speed, applying the necessary safety devices to shut off steam in case of an excessive increase and sufficient strength of parts to take up the energy due to sudden increase of load causing a reduction in speed.

An example of this method of design and manufacture is that of the engines in the power-house of the Derby Street Railway, Derby, Conn.; the engines are 18x30. All are Corliss direct connected to 200 kw General Electric Generators each rig making 150 r. p. m. (750 ft. piston speed per minute); average car load 100 to 125-hp; economical load of engines 225 hp; safe load for 24 hour runs 400 hp; while ultimate load of 550 hp would not break down the engines; besides the governor cut-off there is an automatic cut-off valve above the throttle which closes between any set limits of speed. In this case it will be noticed the large difference between average car load (125 hp) and economical load of engines (225 hp) is due to heavy grades with all cars ascending at the same time.

Were the above method generally followed we would not hear of bursted wheels or wrecked engines except from causes beyond our control. CHARLES HENRY DAVIS.

New York, N. Y.

To the Editor of The Electrical World:

Sir:—It appears to me the hypotheses advanced by Mr. Coykendall are sound and, would undoubtedly afford an explanation of many of the destructive accidents to central station fly wheels, which are now of such common occurrence. It seems to me, however, that the opening of the automatic cut-out in the central station should be regarded by the station engineer as a danger signal, and that the cut-out should not be replaced immediately without a slight investigation of the conditions of the lines and station machinery, which would obviate throwing upon the engines the sudden loads of which mention is made.

In my own practice, in the construction of some three hundred miles of electrical railway, I made it a point to place tell-tale lamps in all the circuits in such a way that the engineer could rapidly make a measurement of the circuit resistance and determine whether, or not, a short circuit continued, to exist. In many cases, the throwing of the automatic was simply due to a sudden extra current, the circumstances causing which were removed before the engineer could make the necessary line test. Therefore, when the lamp rheostat was thrown on the line, it indicated the normal condition and the circuit breaker was replaced. It will naturally be advanced that such a proceeding as this involved a few moments' stoppage to the operation of the road, which is perfectly true, but in the stations of which I speak all the machinery was designed to carry forty per cent. of overload with ease, and the cicriut breakers were adjusted so that they would not open unless this maximum was reached. If the circuit breakers opened, the engineer might understand that some serious cause had affected the circuits and therefore would not replace them until he ascertained that the difficulties had been cleared away.

Chicago, Ill. A. V. ABBOTT.

To the Editor of The Electrical World:

Sir:—I do not believe that the breakage of fly wheels is due to the cause which Mr. Coykendall assigns. From investigations I have made in a number of cases, I believe it is due to the following causes:

Most of these accidents have occurred, as far as my observation has gone, in stations where there are several generators independently and separately belted to Corliss engines. There is no question of the advantage of large units independently connected, either by belting or direct mounting on shaft of engine, but it has led in a number of cases to considerable trouble, and has been, I believe, the real cause of accidents where these engines do not closely balance with one another in their regulation, and get so far out in some cases as to cause a reversal of the generators, and thereby lead to a combination of circumstances causing breakage of a fly wheel. I have seen engines on work of this kind with variation as high as 6 or 8 per cent.

Fly wheels in many cases are not properly proportioned, well designed, or built to give good fair regulation under the trying conditions of railroad work. The remedy is easily to be found in better proportioned and heavier fly wheels, made of better material, and the engine so built as to give close regulation. I do not think that it can be shown that there is any station where such an accident as referred to occurred in which the engines are giving a fairly close regulation (within 3 per cent.) and where the wheels have been properly proportioned to the work to be done.

New York. C. J. FIELD.

To the Editor of The Electrical World:

Sir:—Mr. Coykendall's letter on fly wheel accidents in railway power plants contains an interesting suggestion. His argument is that the fly wheel breaks owing to the sudden application of excessive load to a wheel having great momentum, by the closing of a circuit breaker opened by a short circuit which is still existent at the time the breaker is closed.

It is more usual to consider the strain on the fly wheel to be caused by the sudden withdrawal of the heavy load (due to the short circuit when the breaker is open. In either case the point is the instantaneous change from full to no load. With an experience since 1886 the writer has never known of a fly wheel accident which could be attributed to any such cause. Time and again he has seen circuit breakers open and shut till the engine "staggered," but never with any apparent harm to the engines. The usual danger feared is from burning out of the armatures.

Will Mr. Coykendall favor us with a list of the accidents where he surmises his explanation would hold, and tell us if he thinks the proportion of bursting fly wheels in street railway plants exceeds or anywhere near equals that, say, in mill work. In the list of street railway accidents will he please state the size, make, etc., etc., of engines and wheels, as the safety factors for slow and high speed work are not the same. J. STANFORD BROWN.

New York, N. Y.

To the Editor of The Electrical World:

Sir:—Regarding the letter of Mr. Coykendall with reference to the breaking of fly wheels, I would say that in general I agree with the opinion expressed. I think, however, that when a short circuit occurs on the line and the station attendant closes the circuit breaker, the fuses should be kept in such condition that they will immediately blow out and protect the generator and relieve the load on the engine. I think the trouble is due primarily to the use of slow speed engines running one generator. In such a combination suppose, for example, that at the beginning of the stroke the load is very light, the cut-off works quickly, steam admission to the cylinder is stopped, and a short circuit occurs on the line, the fly wheel being depended upon for the power required, and vice-versa. If the load is heavy at the beginning of the stroke and then suddenly relieved, there is more steam in the cylinder than is necessary to do the work and the fly wheel must be depended upon to counteract it. Both of these cases cause a great strain on the fly wheel, the amount of which we cannot determine. I am neither a believer in high speed nor low speed engines for railway work and I think that an engine running from 120 to 150 revolutions per minute will give the best results, as it gives the governor a better chance to help relieve the sudden changes of load; and, at the same time, such an engine can be built so as to be economical of fuel.

New York, N. Y. L. W. SERRELL.

To the Editor of The Electrical World:

Sir:—The statement of causes in the letter of Mr. Coykendall as to fly wheel accidents seems to me correct. He has not, however, mentioned one of the most fruitful sources of accident, i. e., a very greatly increased centrifugal force due to the running away of the engine when the full load is suddenly removed from it. It is my opinion that, both as regards safety and as regards economy in operation, the fly wheels on street railway engines have been made too light in the past. An extremely heavy fly wheel is desirable as a means of storing energy so as to cause a tolerably uniform steam cut off, notwithstanding rapid and violent fluctuations in the load. To make these heavy fly wheels so that they shall have sufficient strength for the extraordinary strains possible in railway practice, the wheels should be cast in sections so that each spoke with its section of the rim is a separate casting, and the castings should be then all properly bolted together. Or else the fly wheels should have a solid web made of boiler iron, and a rim similarly built up of boiler iron riveted together.

New York, N. Y. H. WARD LEONARD.

To the Editor of The Electrical World:

Sir:—I do not consider that a suddenly applied load is likely to cause the breaking of fly wheels. It is true that there is a very heavy load thrown upon a generator switched in on a short circuited line under full voltage. If this load is transmitted to the fly wheel through an elastic belt capable of slipping on the pulleys, the cushion thus obtained is sufficient to leave a large margin of safety ordinarily. In the case of direct coupled generators and engines there is nothing but its own inertia tending to wreck the fly wheel. In all cases the inductions of the armature, series fields, and circuit breaker coil, do much to keep the current below the point to which it would rise if controlled by the resistance of the circuit only. I think that inherent weaknesses, damage from blows from other broken parts, and speeds above normal, are the three most probable causes of fly wheel accidents.

Lynn, Mass. MAURICE HOOPES.

To the Editor of The Electrical World:

Sir:—When an engine is suddenly loaded beyond the power of the steam pressure on the piston to move it, the accumulated work stored in the fly wheel rim takes up the load and causes a stress on the fly wheel arms similar to a beam loaded at one end and fixed at the other, in order to transmit the work in the rim to the shaft and thence (unless the fly wheel is a band wheel) to the machine driver. Vice-versa, when an engine is suddenly unloaded the work of the steam is stored in the fly wheel until its maximum speed is attained, putting a similar stress in the opposite direction on the fly wheel arms. See for mathematical discussion of this *The Relative Proportions of the Steam Engine*, by myself. WM. D. MARKS.

Philadelphia, Pa.

To the Editor of The Electrical World:

Sir:—I have no doubt that the circumstances which Mr. Coykendall describes are frequently present, and that engines are often severely over-taxed by suddenly throwing on an excessive dynamo load. Whether such conditions would be sufficient to account for any particular accident naturally depends on the particular circumstances of the case. J. LESTER WOODBRIDGE.

New York, N. Y.

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir: Since the effect of the deviation from the sine form has been realized, the question as to the best form of alternating current curves has received greater consideration. Different alternating current machines give differing curve forms, depending on the magnetic conditions. In fact, in the same machine different curves of E. M. F. can be obtained by changing the connections of the winding; and even with fixed conditions in the machine the E. M. F. curve is different in form at different loads, owing to the change in the armature current and the pulsations in the magnetizing current.

Under the many forms three characteristic curves may be distinguished:

First—The flat curve, in whch form the curve rises rapidly from zero, then remains practically constant, and finally falls rapidly to zero again.

Second—The peaked curve, in which form the curve rises slowly at first, then rapidly, to its maximum value, immediately drops again, and finally falls slowly to zero.

Third—The sine curve, which lies between the two characteristic forms mentioned above.

Each of the above forms has its special advantages, so that we cannot decide on any one form without consideration of the conditions.

The amplitude, i. e., the maximum value, with the same mean pressure, is smaller in the flat curve than in the peaked curve. The insulation of the winding of the dynamos, of the conductors and cables, must therefore be higher for the peaked than for the flat form of curve. The wire space can therefore be made use of to better account when the flat curve is chosen.

The flat form is also favorable in lighting. As far as incandescent lamps are concerned, the form of the curve is of no importance, as no difference can be detected with differing curve forms. In the arc light, the form of the curve is of considerable importance. The potential difference at the carbons of a burning arc lamp, other conditions being the same, is greater in proportion as the curve is flatter. This potential difference is a function of the amplitude of the current curve. With a peaked curve this potential difference at the carbons of the lamp would be 25 per cent. less than with the flat curve. With a given potential on the line, therefore, more lamps can be connected in circuit with the peaked curve. The light produced per watt consumed in the lamp has, however, been found to be 20 per cent. less with the peaked than in the flat form of curve. The efficiency of the arc lamp is therefore greater for the flat than for the peaked form of curve.

The humming of arc lamps depends on the greater or less rapid rise in the E. M. F. curve. The steeper the rise or fall in the

different parts of the curve (the greater the value of $\frac{I\,d}{d\,t}$ in different parts of the curve), the greater will be the tendency for the lamp to hum. Hence it follows that with the use of the sine curve the lamp makes less noise than with the peaked or flat curve. If the curve is distorted by rapid steep incisions the noise becomes louder, and besides the fundamental higher tones are heard.

In transformers and motors the use of the peaked form of the curve has the advantage over the flat form in that the energy of magnetization, with the same mean E. M. F., is less. The magnetizing energy was found, for example, for an iron-clad transformer with curve forms which differed greatly from the sine curve, the ratio of amplitudes being 1.77 with the same mean pressure. When the peaked curve was used this energy amounted to 305 watts; with the flat curve it amounted to 437 watts. The energy of magnetization was therefore 43 per cent. higher on the flat curve.

It follows therefore that as far as the magnetizing energy is concerned, the efficiency of transformers and motors is higher with the peaked than with the flat form of curve. Since, however, this magnetizing energy is only a small fraction of the total energy in good motors and transformers, the efficiency is but slightly lowered.

The torque and output is not very different for different forms of curve.

The sine curve possesses special advantages in the following cases:

Through the main current in the armature E. M. F.'s are set up in the magnetic windings, as a result of which the magnetizing current is changed from a direct current to a pulsating current. This pulsating current is the sum of a direct current and an alternating current, the alternating current having double the periodicity of the armature current. With sine curve currents in the armature these alternating currents set up will also be approximately sine curves. With a simple alternating current the magnetizing current becomes

$$I = i_0 + i \sin 2\phi$$

With a polyphased current these induced E. M. F.'s partly neutralize each other. For sine curve forms we would have, for example, with three-phased currents,

$$I = i_0 + i \sin 2\phi + i \sin (2\phi + 120°) + i \sin (2\phi + 240°)\ i_0$$

That is to say, the pulsations in the magnet coils are weaker in proportion as the curve form of the armature current approaches the sine curve. Through these pulsations of the magnetizing current, the E. M. F. curves of the armature are distorted and the mean value of the E. M. F. affected. It follows that the effect of this magnetizing current is smaller the nearer the armature currents approximate the sine curve.

With the sine curve the combination of two such curves shifted out of place is again a sine curve. For example, the sum of two curves of the same amplitude differing in phase by 120° is equal to a curve differing in phase by 60° from the first and having the same amplitude and the same mean square.

$$e \sin \phi + e \sin (\phi + 120°) = e \sin (\phi + 60°)$$

It is therefore possible to join E. M. F.'s, and have the form

$$e \sin \phi, \text{ and } e \sin (\phi - 60°) + e \sin (\phi + 60°)$$

in parallel.

For curves that differ from the sine form of the curve, say $f(\phi)$, the sum is $f(\phi) + f(\phi + 120°)$, a curve which, if $f(\phi)$ is symmetrical, differs in phase by 60° from it, but is neither of the form, nor of the same amplitude, nor of the same mean square as the curve $f(\phi)$. If electromotive forces of the forms

$$f(\phi), \text{ and } f(\phi - 60°) + f(\phi + 60°)$$

are joined in parallel, large reactance currents are given rise to, which, as can be readily shown, have triple the periodicity of the original currents. This case arises, for example, when in using three-phased dynamos, transformers and motors, they are connected up triangularly. The reactance current is to be found also in dynamos running without load, and may become under certain conditions so large that it becomes almost equal to the normal current; as a result of which the output of the dynamos, transformers and motors is diminished and the efficiency is lowered due to the increased heating. With the use of the sine curve the reactance current, as we have seen above, becomes zero.

In order that no reactance current shall arise in plants in which the dynamos are run in parallel, the machines must have the same form of curve. Furthermore, it is to be observed that with curves differing from the sine form the diagram constructed for the combination of currents does not give accurate values, as this diagram is only correct for sine form curves. Hence we cannot replace non-sine curves by so called equivalent sine curves, that is, curves having the same mean square and which give equal values as one special sine form curve.

For example, for an E. M. F. curve whose amplitude was 1.120 of the mean value of the E. M. F., we have the following results:

	Mean E. M. F.		Amplitude.
	Observed.	Estimated.	Observed.
Simple curve....................................	100	....	1.120
Sum of two curves differing in phase 120°....	108.5	100	1.982
Difference bet. two curves diffr'g in phase 120°	167.2	173.2	1.303

The difference between the observed values and the value calculated from the diagram are so large that they must not be neglected.

In ordinary alternating current practice, dynamos with both flat and peaked curv are used. The alternating current machines of almost al. makes differ in the form of their E. M. F. curves; even dynamos from the same factory have often curves differing from each other. This lack of uniformity has great disadvantages, whereas in direct current practice the type in any well built dynamo is of no importance, such is by no means the case with alternating current machines. In alternating current practice the arc lamps must be regulated for the special curve form of the dynamo with which they are to be used; the measuring and regulating devices operate, under certain conditions correctly, only with a given curve from; the dynamos with different curve forms cannot advantageously we run in parallel, etc. The dynamos, lamps, measuring and regulating apparatus cannot therefore, off hand, be used indiscriminately in stations having different curve forms and, in the same way, they cannot be obtained indiscriminately from any firm.

It would, therefore, be of great value if uniformity was aimed at, if all makers of alternating current apparatus would decide on some one form of current curve. The production of alternating current apparatus with a given form of curve will hardly cause any great difficulty in the present state of the art. It is an advantage to choose a curve having as simple a mathematical formula as possible. This condition is satisfied by the sine function. The sine curve might therefore be recommended as the form to be chosen as the universal current curve in alternating current practice.

Charlottenburg, Germany. SIEMENS & HALSKE.

The "London Electrician" of September 14 contains a communication from R. Shand, of Lynn, Mass., in which he states that the views expressed by that journal probably accord quite as well with the real views of Amrican manufacturers generally as do those it ventures to criticize. He believes that manufacturers in general are concerned very little with the form of wave given by their alternators, and that those with iron-clad armatures are so satisfactory that they have almost entirely superseded those having smooth core armatures. The former, in his opinion, are vastly better from a mechanical standpoint, and their possible output is from 60 to 75 per cent. greater, though they do not give anything resembling sine waves. He also believes that facts indicate the possibility of securing much higher efficiency with alternators giving comparatively irregular waves.

Trouble with Chicago Awards.

The jury awarded two prizes to the Pope at Rome and the Italian Government is now in a dilemma; if it recognizes these it will be treating the Pope as an Italian subject and if it does not recognize them it will be ignoring the distinction conferred on his two exhibits.

Clark Cells.

Mr. Skinner, in a London Physical Society Paper, has shown that the current from a standard Clark cell with 10,000 ohms in series, is far below the safe limit of current density and one need therefore not fear to take a current from such a standard cell under these circumstances.

Light for Refuse.

The town of Ealing, in England, with a population of 27,000, is about to systematically tackle the much vexed question of the destruction of the town refuse and the generation of electric light by the same plant. The results will be awaited with much interest.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Heat of Dissociation.—A paper by Mr. Ebert, from "Wied. Ann.," No. 10, 1893, on the heat dissociation according to the electro-chemical theory, is published in the "Phil. Mag." for September. Among his conclusions are the following: He shows that the "whole work required for the dissociation of hydrogen and iodine molecules is used in overcoming the purely electrical forces of the valency-charges;" "that the forces of chemical affinity are essentially of an electrical character; that the electrostatical forces which the charges exert on each other at the positions of valency are by far the most powerful among the forces exerted among the atoms;" and that according to von Helmholtz, "particular possible chemical forces of the charged atoms can be but infinitely small in comparison with electrical forces" "This seems of great importance for the theory of chemical forces in general."

Currents in Open Circuits, Dielectrics and Electrolytes.—A brief abstract of Mr. Nicolaieff's paper, mentioned in the Digest last week, is given with a few of the results, in the Lond. "Elec.," Sept. 28.

Action of Alternating Currents on Dielectrics.—The discussion on this subject is continued by Mr. Addenbrooke, in the Lond. "Elec. Rev.," Sept. 28, giving, however, nothing new.

Determination of Dielectric Constants.—A paper from the Italian, by Mr. Campetti, is published in "L'Eclairage Elec.," Sept. 22.

Light from Electrical Oscillations.—The "Elek. Echo," Sept. 29, publishes an article on Prof. Ebert's luminescence lamp (see Digest Oct. 6).

MAGNETISM.

Energy of Magnetization of Iron.—In an article by Mr. Peukert, in the "Elek. Zeit.," Sept. 27, he gives the formula for calculating the energy and describes a series of researches made in order to determine the connection between the work consumed in magnetizing iron, and that represented by the change of form of the iron on being magnetized; also to find whether the former finds its entire equivalent in the latter. In a series of researches, the results of which are given in tables and curves, he measures both of these quantities; he finds that with increasing magnetizations there is at first an increase in the elongation of the iron, then a maximum is reached, after which there is a continual shortening; the ratio of the two energies is given in the form of curves, the formula for which is promised in a subsequent article; it appears from this that only a very small part of the magnetization energy is represented by the work consumed in a mechanical deformation, and that, therefore, the largest part of it is transformed into heat.

Magnetic Shielding.—A short Physical Society paper, by Prof. Perry, on the simplest case of magnetic shielding by a hollow iron cylinder, is published in the "Phil. Mag.," for September. It is mathematical in character.

Equilibrium of Magnetic Liquids.—A paper from the Italian, by Mr. Mortara, of a mathematical nature, is published in "L'Eclairage Elec.," Sept. 22.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Potentiometers for Alternating Currents.—The following method by Mr. Swinburne, is described in the Lond. "Elec. Rev.," Sept. 28, for calibrating alternating current instruments by measuring or balancing against a continuous current. It is a zero method. For voltmeters the instrument is shown in Fig. 1, in which *h* is the voltmeter to be calibrated,

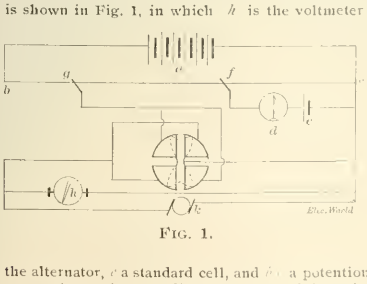


FIG. 1.

k is the alternator, *c* a standard cell, and *b* a potentiometer wire. A resistance not shown in the diagram, is placed in series with this wire to adjust the current strength; this adjustment is made so that the standard cell is balanced when contact is made at *f*, at the mark corresponding with its E. M. F. The differential electrometer is connected as shown; the double fish-tail shaped needle is pulled in opposite directions by the continuous and the alternating E. M. F.'s; the fish-tail shape is necessary to insure that the needle is in stable equilibrium when the forces are equal; there is no controlling force except that due to the suspending fibre; an instrument indicating one volt, when there is no pressure on the other side, will enable two pressures of 100 volts to be compared within one in ten thousand, and 2,000 volts within one in four million. To find the true zero of the instrument the four quadrants are connected together. Fig. 2 shows an arrangement for measuring

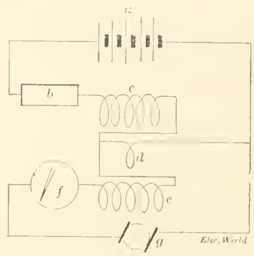


FIG. 2.

the current, consisting of a differential dynamometer having two fixed and one movable coil, represented by *c* and *e* and by *d* respectively. There is no opposing spring to keep the movable coil in place, it being brought to zero by making the opposing forces equal. The direct current is measured by the fall of potential in the low resistance *b*; *f* is the alternating amperemeter to be calibrated; *c* and *e* are wound close together, so that there is no appreciable time lag in any current in *e* induced by *c*, the small error due to the mutual induction of these coils canceling out; a method with no mercury contacts might be devised, in which case greater accuracy might be obtained. Mr. Blakesley pointed out that the comparison was really one of powers, which, however, does not detract from the practical value of the method.

Definition of E. M. F.—In the Lond. "Elec. Eng.," Sept. 28, Mr. Giorgi contributes to the discussion on this subject, and offers the following definition: "Every current flowing in a circuit has always to overcome some oppositions, because in its flow it always generates some kind of work; therefore, it cannot be maintained unless some exterior factors, acting on the circuit, assist the flow by supplying to the current the energy it is spending elsewhere. Every one of these agents is called a source of E. M. F. It is incorrect to speak of them as sources of electricity, because electricity, like matter, cannot be generated or destroyed, but only set up into circulation. A source of E. M. F. applied to a circuit, is, therefore, everything that forces or tends to force electricity into a certain motion along the same, and in so doing it necessarily impresses a power when this motion really takes place." He discusses the subject, and states, among other things, that an electromotive force and a Newtonian or ponderomotive force are of a quite different nature, for the one acts on electricity and the other on matter; but the work done by the one in displacing electricity, and by the other in displacing matter, is absolutely of the same kind, and may be expressed in terms of the same units.

Reactance.—"L'Ind. Elec.," Sept. 25, contains an article by Prof. Blondel, in which he discusses the definition of this word, and criticises very unfavorably that contained in a recent Institute paper on reactance (by Messrs. Steinmetz and Bedell, in The Electrical World, June 30). A translation of Prof. Blondel's paper is given in full in another part of the present issue. He claims that it has not been duly recognized that this term was first proposed by the French International Society of Electricians in 1893. (The compiler calls attention here to the fact that in the article published in The Electrical World, May 26, p. 712, due acknowledgment was made).

Photometric Units and Quantities.—A translation of the complete article by Mr. Blondel, abstracted in the Digest Aug. 11 (see also Aug. 25 and Sept. 22), is published in the Lond. "Elec.," Sept. 28. It is also discussed at some length editorially, where it is regarded as a most re-

markable contribution to physical nomenclature, but, though a sound system, it is believed that the auther goes rather far. The unit of luminous flux may deserve a name, but it cannot be a candle, as the idea that one candle-power gives a light of $4.\pi$ or 12.57 candles, though technically true, would be too absurd: unless some name is adopted, enterprising lamp makers will advertise lamps of 201 candles, meaning 16 candle-power. The unit "illumination" really needs a name; it is suggested that the three similar units in his table may be reduced to a single unit as their dimensions are identical; this is discussed at some length. As a matter of some interest in connection with dead white reflectors, it is stated that a perfect white reflector of one square foot illuminated with π candle-feet, emits one candle-power normally. The French term "illumination" refers to nothing more or less than the photographer's term "exposure."

Photometer.—The Drossbach photometer is briefly described with the aid of an illustration in "Cosmos," Sept. 22. It consists essentially of two mirrors, each at an angle of 45 degrees, with the two rays from the sources, and with the line of sight. They are also perpendicular to each other, one being in front of the other, the front one having a hole in it through which the light from one source passes to the eye, while the light from the other source is reflected to the eye by means of the front mirror. The two sources are thus compared, the illuminations appearing like in the Lummer-Brodhun photometer, over which it has the advantages that there are no prisms, that it is very much cheaper, and that the rays from the source of light need not be perpendicular to each other.

The Clark Cell when Producing a Current.—A Physical Society paper by Mr. Skinner is, published with illustrations, in the Lond. "Elec.," Sept. 28, and in the "Phil. Mag." for September. He constructed some large cells, and describes experiments made with them, giving the results in a table; he shows that the cell recovered its E. M. F. entirely after having given current, stating that this is a typical instance of the behavior of the cells; a curve of discharge is given. He shows that the E. M. F. of depolarization varies directly with the current density in a particular cell, and that it increases slowly when the current is maintained; he concludes that the small currents of approximately known value can be used with large Clark cells of small internal resistance which may be neglected in comparison with the large external resistance. With a large cell a current of 0.01 ampere could readily be used, corresponding to a density of 0.0001 ampere per square centimeter of zinc. Comparing this with the Board of Trade pattern, he shows that the current taken when connected with a resistance of 10,000 ohms, is very much below that which has been found to be safe in these experiments.

Conductivity Balance.—An instrument made by Messrs. Elliott Bros. is illustrated and described in the Lond. "Elec. Rev.," Sept. 28, and is intended for workshop use for testing large samples with the greatest possible accuracy. It is based on the Thomson bridge, the wires to be measured being placed in series with the standard length. Bars one meter long and three-quarters of an inch in diameter can be tested. A resistance of five millionths of an ohm is easily measured.

Conductivity of Salts.—A paper by Mr. Voellmer, from "Ann. Phys. Chem.," is briefly abstracted in the Lond. "Elec. Eng.," Sept. 28. It treats of salts dissolved in alcohol.

Resistance of Solutions Under Pressure.—The article by Mr. Peisch, abstracted in the Digest Oct. 6, is given in abstract in the "Phil. Mag." for September.

Resistance Box.—A new form by Hartmann & Braun, is illustrated and described in the "Elek. Zeit.," Sept. 27.

Construction of Resistances.—Mr. Morris' article is continued in the Lond. "Elec.," Sept. 28. He describes, with the aid of a number of illustrations, the construction of resistances.

Thermometers of Ethometers.—An editorial in the Lond. "Elec. Rev.," Sept. 28, suggests the use of thermometers as measurements of ether, apparently using the term ether and electricity synonymously. It intimates that we shall most likely arrive at the notion that absolute temperature means absolute molecular contact, free from ether intersperion.

Determining Transition Points.—A paper by Mr. Cohen, from the "Zeit. Phys. Chem." is briefly abstracted in the Lond. "Elec. Eng.," Sept. 28. If a voltaic element be formed by the immersion of similar electrodes in saturated solutions of the two forms of the substances capable of undergoing a transition change, then at temperatures above or below that transition, the current will flow in opposite directions, becoming zero at the transition temperature itself; he uses this method in a number of investigations. It has the advantages of accuracy and speed, but is applicable only to conductors.

Board of Trade Laboratory.—The Lond. "Elec. Eng.," Sept. 28, begins a description of the laboratory and instruments at Whitehall. The laboratory will be controlled by the Board of Trade, and in it will be constructed the Government standards. It will provide facilities for testing commercial instruments. It will include a gas engine and storage battery plant, besides having connection with the city mains for obt ing alternating currents, including those from the Ferranti station for potentials up to 10,000 volts.

DYNAMOS AND MOTORS.

Design of Large Alternators.—Mr. Kennedy, in the Lond. "Elec. Rev.," Sept. 28, refers briefly to the broad principles governing the design, applicable equally to continuous as well as to alternating generators. He divides the latter into three general types—the Siemens, the Gramme and the Lontin. The first type still holds its own, and the four following requirements of a good design are as well met as they can practically be. (1) The flux through the coils rises gradually, the permeability being constant in the armature. (2) The magnetic flux through the field is steady. (3) The magnetic leakage is steady, proved by the non-heating of the poles. (4) There are no laminated cores, reducing the hysteresis and the eddy currents to a minimum. The magnetic leakage is not a minimum but it is quite as great in most other types. The Mordey design is a modification of it, the leakage there being reduced to a minimum. In this form there are no laminated structures, which is a most important point. The Gramme form is next best, but requires a laminated core, introducing hysteresis losses. If the windings lie between teeth or in holes, a variable flux is introduced, but it otherwise fulfils the requirements of a good design. The Lontin type is at present a great favorite. It is now built with a laminated magnet and a laminated armature. There are outward projecting poles carrying the exciting currents, and a concentric massive frame carrying laminated blocks encircled by the armature coils. With such a construction none of the requirements of a good design are obtained. (1) The flux through the coils does not vary gradually. (2) The flux in the field pulsates, setting up hysteresis and eddy current losses. (3) The magnetic leakage is greater than in other designs. The enormous amount of lamination makes it very expensive. The losses increase as the load decreases. When well laminated it may give a higher output than other types, but this is a doubtful advantage.

Graphical Calculation of Dynamos.—A French translation of the article by Mr. Fischer-Hinnen, mentioned in the Digest, Aug. 18, is begun in "L'Eclairage Elec.," Sept. 22.

Brushes.—A German company advertises a new patent brush cased in aluminium, which consists of extremely fine wires woven together, making an almost homogeneous mass. It is stated that 13,000 of these wires will together form a brush of one square centimeter cross-section. A fraying out of the wires is claimed to be impossible. They are guaranteed to last four times as long as any other brushes.

ARC AND INCANDESCENT LIGHTS.

Arc Lamp.—"L'Elec.," Sept. 22, describes a lamp for which claims of great simplicity and cheapness are made. The feeding is done by means of an escapement, like in a clock, the lever being operated by a shunt magnet, whose current is made and broken by the movement of the lever itself. The arc is established by a series magnet. Good illustrations are given.

Projectors.—The article abstracted in the Digest, Oct. 6, is continued in "L'Eclairage Elec.," Sept. 22. It is of a mathematical nature, and discusses the determination of the lighting power of projectors.

Lighting of Interiors.—An article of but little interest, including some comparative estimates for the cost of arc and incandescent light for interiors, is published in "Ind. and Iron," Sept. 7.

Street Lighting.—An article, by Mr. Gay, is published in London "Lighting," Sept. 20.

TRANSMISSION OF POWER.

Di-phase Transmission Plant.—A short description of the plant in the Decize mines, abstracted in the Digest, July 14, is published in "L'Eclairage Elec.," Sept. 22.

ELECTRIC RAILWAYS.

Liverpool Overhead Railway.—The report of the dscussion (see Digest last week) is concluded in the Lond. "Elec.," Sept. 28. The first part is devoted to the civil engineerng features only. Mr. Moss gives some comparative figures for the Manhattan Elevated Railway, and Mr. Nichols for the Brooklyn Elevated Railway. Traffic on the Liverpool line is about one-seventh that on the Brooklyn, about one-thirtieth of that of the New York line, and about 20 per cent. less than that of the Fifth avenue branch of the Brooklyn line. He stated that the electric conductor and wire were simpler and in every way better than those on the Intramural Railway at Chicago. He believes that if the developments of dynamos and motors continue to improve as they have done during the past four years, no one would think of operating elevated railways of the future by any other medium than electricity. He gives a table illustrating the results obtained as regards station spacing, tim and speed for the Liverpool, the Brooklyn, and the two Chicago lines. Another, giving the working expenses of the Liverpool, Manhattan and Brooklyn Elevated Railways. Dr. Preller, of Switzerland, discussed the subject of locomotives vs. motor cars, stating that it is very hazardous to generalize, and that each case must be judged on its merits. He found, for instance, that on steep gradients the train load for 50 passengers by motor cars, electric locomotive and steam locomotive, was 1 to 1½ to 2, but on ordinary gradients the proportion was very different as the number of cars increased. With two or three cars the weight was

about equal. With four cars the electric locomotive possessed a decided advantage over motor cars. It also insured easier and safer manipulation of the trian by one man. He compared the Liverpool motors with those constructed by Messrs. Brown, Boveri & Co., showing that the latter gave, at less weight per unit, considerably more power than those used at Liverpool. Mr. Robinson criticised severely the statement regarding the 88 per cent. efficiency. Captain Sankey called attention to some anomalies in the load curves. In conclusion, Messrs. Parker & Greathead replied to the discussion.

Electric Locomotives in France.—The Lond. "Elec.," Sept. 28, abstracts from the London "Engineer," stating that the Paris-Lyons and Mediterranean Railway is now building 60 electric locomotives, each capable of drawing 800 tons at a speed of 15 miles per hour, and also electric locomotives, "the motor of which is mounted on the rolling stock."

Sectional Contact Rail System at Lyons.—The article abstracted in the Digest last week, is concluded in "L'Elec.," Sept. 22. The distributor is described at some length for the case of a single track over which cars move in both directions. The distributors also form a sort of block system, preventing two cars from getting into the same block controlled by one distributor. The shoes for making contact are illustrated and decribed. They are made of cast iron, and are fixed at the end of permanent m gnets so that their magnetic attraction to the contact rail forms the contact, while between these sections a spring raises them off from the pavement. A diagram gives the complete wiring of the car. Over 123,000 passengers were carried on this line during August. A translation of the article abstracted in the Digest last week, is given in abstract, together with some illustrations, in the Lond. "Elec.," Sept. 28.

Lyons-Oullins Railway.—The illustrated description, mentioned in the Digest, Aug. 4, is continued in the Lond. "Elec. Rev.," Sept. 28.

Havre.—An illustrated description of this line, installed by the Thomson-Houston Co., is published in "L'Ind. Elec.," Sept. 25.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Central Station Operation.—The leading editorial in the Lond. "Elec. Rev.," Sept. 28, on the working of central stations, calls attention to a few of the smaller economies in running a central station. It recommends that all stores, including coal, should be kept under lock and key and be obtained only through a formal demand. It advises not to change the men about from one watch to the other and to promote a system of healthy rivalry between the watches; comprehensive report books should be used in each department and each man should be provided with a time sheet; the information should be collected once a week, analyzed and tabulated, showing at a glance what it costs to generate and distribute the current for each week; in small towns the meters should be read once a week.

Ealing.—The Lond. "Elec. Eng.," Sept. 28, publishes at considerable length, with the aid of a number of illustrations, a description of this plant which is about to be inaugurated. It is of special interest, as the source of power will be largely obtained from refuse destructors, and it is said to be the first municipal plant in which this method will be systematically carried out. The population is 27,000, and the plant will have a capacity of 5,000 lamps of 8 cp.; the charge for current will be 12 cts. per kilowatt-hour for lighting and 8 cts. for power; in order to obtain water for condensation the generating station is some distance from the town, and therefore the high tension alternating system will be used.

Zurich.—A description of this installation, including considerable data, is published in the "Elek. Zeit.," Sept. 27.

Nancy.—A small accumulator plant is described and illustrated in 'L'Ind. Elec.,' Sept. 25.

New Form of Lightning Arrester.—In the "Elek. Zeit.," Sept. 27, Dr. Muellendorff describes a simple form, the object of which is to avoid the trouble caused by the arc, in burning the contact points of the usual lightning arrester; the object is to avoid all sparks and all possibilities of the formation of an arc, and he accomplishes it by an apparatus through which there will be a continuous discharge of atmospheric electricity, while under ordinary circumstances no current will flow. He inserts paraffine paper between two blocks of carbon; when connected with a small influence machine it was found that there was a continuous equalization of the potentials without the formation of sparks, but when connected to electric circuits of the usual voltage, the paper acts as an insulator; the apparatus itself is made of a pile of four or more carbon disks, secured in a closed glass tube and separated from each other by several thicknesses of paraffined paper, connections between the top and bottom carbon being made with the line and the earth respectively; the number of carbons must be proportioned to the voltage of the circuit and their surface to the probable discharge of atmospherical electricity; it has been in use for a year and has proved itself to be very successful; it is applicable also to telegraph and telephone lines.

Regulating Gas Motors.—In "L'Ind. Elec.," Sept. 25, Mr. Wild criticizes the recent paper of Mr. Picou (see Digest, Sept. 8). He differs with that writer in regard to the inefficiency of the flexible spring coupling, giving his reasons; he cites two cases in which the Raffard elastic coupling was used, and in which no perceptible flickering in the light could be noticed, while when that coupling was cut out the flickering was very bad; the oscillations of a volt-meter in one of these was reduced from 4 to ¼ of a volt. He suggests that manufacturers should construct gas engines especially for electric lighting, with a short stroke, a great angular velocity, large bearing surfaces and heavy fly-wheels; the fly-wheel and special bearings might be provided separate from the engine. In a reply by Mr. Picou he states that he came to his conclusions from the failure of such a coupling, and in which he found that the flickering was increased; he discusses the theory and continues to believe that such a coupling increased the evil.

Accumulator Regulator.—The Trumpy apparatus for accumulator regulators, mentioned in these columns several times before, is described and illustrated in "Ind. & Iron," Sept. 14.

Steam Turbine.—An article by Mr. Edgecombe is begun in the Lond. "Elec. Rev.," Sept. 28.

WIRES, WIRING AND CONDUITS.

Earth Charging from Leaking Mains.—A recent Royal Society paper by Messrs. Cardew and Bagnold, is abstracted in the Lond. "Elec.," Sept. 28. From their experiments they conclude that under very different conditions of weather and moisture in the soil, it is possible to produce a fall of potential amounting to 25 per cent. of the whole pressure (600 volts) between points on the ground four feet apart, and that a horse having a resistance of say 400 ohms would therefore receive a severe shock.

Calculation of Leads.—Mr. Loeffler publishes in the "Elec. Zeit.," Sept. 27, a simple and practical graphical method for calculating leads; it appears to be quite simple and is in some respects better than other similar diagrams, but in some other respects not as good.

Bracket with Fuse.—A new form is described and illustrated in "L'Ind. Elec.," Sept. 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Protection of Railroad Trains.—In "L'Eclairage Elec.," Sept. 22, Mr. Claude suggests, at some length, the elements of a new system in which there is direct communication between two locomotives in the same block; each has a dynamo connected to the axle with one pole to ground and the other connected through a shunted bell to an insulated wire laid along the track in disconnected sections; when two trains are on the same section both bells will be rung.

Telegraphic Connection with China.—According to the "Elek. Zeit.," Sept., 27, there are at present two lines to China, one through Russia and the other by submarine cable; two other lines are to be constructed, one of them requiring an addiiton of only about 180 miles of wires to present systems, and the other from St. Petersburg direct to Pekin.

Atlantic Telegraphy.—It appears from a note in the Lond. "Elec. Eng.," Sept. 28, that the German government is considering the laying of a cable to America via the Azores.

Telephone in Hungary.—According to the "Elek. Zeit.," Sept. 27, it is proposed to connect all the principal towns of Hungary with each other and the capital by long distance telephone lines.

Theory of, and Minimum Current in Telephone.—The two papers by Lord Rayleigh, abstracted in the Digest, Oct. 6, are published in the "Phil. Mag." for September.

ELECTRO-CHEMISTRY.

Alkali and Bleach.—The Castner process (see Digest last week) is described in the Lond. "Elec.," Sept. 28, the description being about the same as that referred to last week. Exception is taken to the figure given for the electrical efficiency, 88.9 per cent., and from some deductions it is shown that an efficiency of barely 50 per cent. is obtained instead of that which is claimed; the cost of the energy required to produce one ton of caustic soda and about 2½ tons of chloride of lime, would be approximately $21 for a large plant; it is concluded that although a good deal of progress has been made, electrolytic soda and bleach will not yet have the market to themselves.

Electrolytic Soda.—An article giving a general review of the subject by Dr. Rideal is published in London "Lightning," Sept. 27. He states that in his opinion the application of electrolysis to the alkali industry will probably be found in its use for decomposing calcium chloride and not sodium chloride, in which case electricity will aid in the existing process; he bases his opinion mainly on the thermo-electric considerations, as the calcium and magnesium chlorides are more easily decomposed than their equivalents of sodium chlorides.

Bleaching.—According to the Lond. "Elec.," Sept. 28, a system is being tried in Germany in which such substances as starch, dextrine and gum are bleached by ozone generated electrically in a receptacle in which a silent discharge takes place, the gas being blown into the liquids through very fine apertures or else the liquids are sprayed into a chamber filled with ozone. Their market value is said to be greatly increased thereby.

Copper Electrolysis in Vacuum.—According to the Lond. "Elec. Rev.," Sept. 28, Mr. Gannon finds that a heavier deposit was obtained under reduced pressure than under atmospheric pressure; the percentage difference was not constant, but the addition of a little sulphuric acid

made it so under this condition for current densities above 0.01 ampere per sq. cm of cathode, there is practically no difference in weight between the two deposits, but for lower densities the vacuum deposit is appreciably higher.

Flocculent Electro-depositions.—The Lond. "Elec. Rev.," Sept. 28, abstracts a paper by Messrs. Mylius & Fromm, from the "Elektrochem. Zeit."

Zincing Process.—A brief description of the Cowper-Coles system, containing but little that has not been published before, is given in "Ind. & Iron," Sept. 28.

Purification of Drinking Water.—The "Elektrochem. Zeit.," September, contains a long article by Mr. Oppermann, in which he discusses the subject and describes a process patented by himself; a description of the apparatus is to be published in a subsequent article. In the introduction he states that a current passed through water has no action in destroying the organisms, but in all natural waters there are small quantities of different salts which, by means of the electric current, can be decomposed, and this under certain circumstances, produces ozone and peroxide of hydrogen, both of which have a cleansing action as they destroy the organism by a process of oxidation.

Purification of Dyes.—According to the "Elek. Anz.," Sept. 9, certain dyes contain metallic salts and other materials as impurities, from which it is freed in the Guillot process by electrolysis, in which process the metallic salts are deposited either on the anode as superoxides or on the cathode as metals.

Production of Sulphuric Acid.—It is stated in the Lond. "Elec. Eng.," Sept. 21, that Mr. Hill has invented an electric apparatus for the production of sulphuric acid directly from sulphur dioxide, by means of an electric current of low pressure; the process, however, is not described.

Velvo Battery.—The Lond. "Elec. Rev.," Sept. 28, contains a communication from the inventor, Mr. Barnet (see Digest Oct. 6 and 13), in the form of a reply and an advertisement; he claims that he can get more watt-hours per dollar than a double fluid cell employing nitrate of soda; the available difference of potential while delivering a strong current, is said to be from .5 to .65 per cell; the cost per kilowatt hour of the lighting type of cell may be less than 37 cts.; for chromic solutions these carbons are but little better than plain carbons, but with nitrate of soda they are much better.

Chemical Theory of Accumulators.—Mr. Wade's article is continued at some length in the Lond. "Elec." Sept. 28; he gives a summary of a number of papers which have been published on this subject, and containing therefore nothing new; references to the originals are given, forming a useful collection of references to the best literature on this subject.

Efficiency of Accumulators.—A translation of the article from the French, abstracted in the Digest, Sept. 8, is reprinted in the Lond. "Elec. Rev.," Sept. 28.

Tudor Accumulator.—A brief illustrated description is published in "Ind. & Iron," Sept. 7.

MISCELLANEOUS.

Welding.—"L'Eclairage Elec.," Sept. 22, contains a well illustrated article by Mr. Richards showing a number of machines and giving the power required under different circumstances; it appears to be compiled chiefly through American sources.

Heating Appliances.—A number of these shown at a recent exhibition at Ealing, are illustrated and described in the Lond. "Elec. Eng.," Sept. 28.

Electric Ventilators.—A description containing the illustrations of about a dozen different forms, is published in "La Nature," Sept. 15.

Firing Mines.—An illustrated description of a small hand dynamo of recent design from a French journal, is given in the Lond. "Elec. Rev.," Sept 28.

Government Inspection in Canada.—An act recently passed for the inspection of meters and the regulation of electric contractors is summarized in the Lond. "Elec. Rev.," Sept. 28.

Electro-therapeutical Apparatus.—An illustrated description of a number of pieces of apparatus is published in the "Elek Echo.," Sept. 29.

Antwerp Exhibition.—The "Bul. Soc. Int.," for July, contains a long illustrated paper descriptive of a visit to this Exhibition; it is the longest and best description which has so far been published.

Educational.—According to the Lond. "Elec.," Sept. 28, the Russian Government has ordered the formation of a military electro technical school to enable the officers to carry out military electrical work and to investigate electrical discoveries and inventions likely to be of use for military purposes; the course will extend over two years; 70 officers will be instructed at one time.

Biographical.—A biographical notice with portrait of Hermann von Helmholtz by Mr. Guillaume, is published in "L'Ind. Elec.," Sept. 25, and in "La Nature," Sept. 22. "Cosmos," Sept. 29, publishes a biographical sketch by Mr. Dufour; another is given in "L Elec.," Sept. 22.

Prizes.—A list of the subjects for papers or which premiums will be awarded by the Institute of Civil Engineers of England, are published in the Lond. "Elec. Eng.," Sept. 28.

New Books.

MECHANCAL DRAWING. Projection Drawing, Isometric and Oblique Drawing, Working Drawings. A Condensed Text for Class Room Use. By Walter K. Palmer, M. E. Columbus, O.: Chas. B. Palmer, 50 pages, 6 figures. Price, 80 cents.

This is a very elementary work on the subject, and is the substance of a progressive course taught by the author at the Miller Manual Training School, Crozet, Va. It is intended only as a "teacher's help," and the rules and hints are of a kind to assist in teaching rather than for the direct instruction of the student.

DYNAMO ATTENDANTS AND THEIR DYNAMOS. A practical Book for Practical Men. By Alfred H. Gibbings, A. I. E. E., London: Sidney Rentall, 58 pages, 14 illustrations. Price, 50 cents.

The matter contained in these pages first appeared in the columns of London "Electricity," and is intended to offer plain hints and advice to the dynamo tender. The author is electrical engineer to the Corporation of Hull, and therefore presumably well qualified to write on the subject. Considerable information useful to the dynamo tender is given, though much of it is explanatory of apparatus and electrical principles rather than of a direct practical character.

The Association Suisses des Electriciens, which occupies the same place in Switzerland that the American Institute of Electrical Engineers does in America, has issued its *Annuaire* for 1894 under the editorship of its President, Dr. A. Denzler, in the form of a brochure of 140 pages. A paper of 44 pages by the President elect, W. Wyssling, accompanied by ten charts of curves, gives an exhaustive account of the construction and operation of the Zurich central electric lighting station. The information is in great detail, the costs of construction, for example, being itemized under thirty heads, and operating expenses are even more fully detailed. Classified tables give the number of electrical plants in Switzerland, from which we learn that there are 617 isolated plants with an aggregate capacity of 7,180 kw, 77,831 incandescent, and 1,446 arc lamps; and 60 central stations with an aggregate capacity of 6,744 kw, 66,488 incandescent, and 680 arc lamps. A table gives full data in regard to the various central stations, showing, among other things, the relative distribution of current for lighting and power. Lists are given of Swiss patents issued during 1893, and of Swiss government officials having a connection with electrical matters, of the electrical and physical faculty of higher schools and colleges, and of Swiss electrical engineers. There are also tables of government statistical information relating to telephones and the elegraph.

The Engineering Magazine, with its October number introduced a commendable feature, consisting of a "Review of the Industrial Press." The sections in the former department devoted to the different important branches of engineering science, to which have been added several others, are each prefaced by a collection of notes referring to the various articles of value bearing on the subject of the respective sections that have appeared in the technical press since the previous issue of the magazine. The more important articles in each branch are also briefly abstracted, with comments in the editorial section following the notes. As the value of the abstracts will largely, and that of the comments entirely, depend upon the professional competency of the writers in charge of the respective sections, we would suggest that the former practice of placing the names of these at the heads of the sections be revived. If, for example, it were known that the electrical department continued in personal charge of Mr. F. L. Pope, readers of it would have that assurance as to the value of the abstracts and the conscientious character of the opinions expressed, which, if absent, would largely lessen their interest in both.

An Arc-Light Regulator.

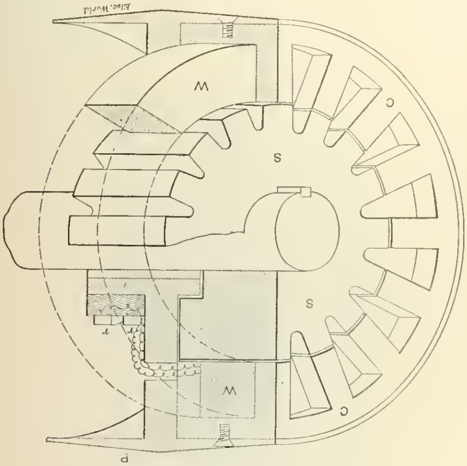
BY F. H. PEMBER.

The automatic regulation of an arc light dynamo has always been a matter attended with considerable difficulty, and necessitating the use of more or less complicated apparatus external to the machine itself. Lately, however, the important effects of self-induction of the armature have been applied as a means of regulation, and, in circuits of many lamps, where counterbalancing effects result in but slight fluctuations of current, will doubtless be a success.

Regulation has hitherto been accomplished by varying one of the three factors of current—number of effective conductors, strength of magnetic field, or speed of revolution. The first factor is the principle involved in the use of the T. H. Wood, and Waterhouse regulators, in which the altered diameter of commutation practically varies the number of effective conductors. The Brush machine is the best example of regulation by changing the strength of the magnetic field. Many pieces of apparatus have been designed to govern the source of motive power, and thereby govern the speed of the dynamo according to the needs of the circuit. Such contrivances must needs be slow in action, and, when more than one machine is connected to a common shaft be entirely inadmissable. The apparatus about to be described is designed to transmit the power to each dynamo shaft in such a manner that no more power will be absorbed than that necessary to keep the required constant current throughout the varying conditions of the external circuit of each particular machine. This is accomplished by means of a magnetic

driving clutch. The apparatus consists of a pulley, P, shown in section in the drawing, which, when the machine is inoperative, runs freely upon the armature shaft. Fitted to the inside of the pulley and fastened to it is a collar, C, supplied with a set of inwardly projecting teeth, similar to an internal gear, but so recessed as to admit the introduction of a coil of wire, W, wound in a rectangular cross section. Firmly keyed to the armature shaft is a "spider," S, having a number of teeth equal to that on the collar, and clearing them by one-hundredth of an inch or so.

Now, when it is desired to set the dynamo in motion, a current of electricity is sent round the coil, gathered from a pair of collecting rings, rr, in which the ends of the coil are terminated. This renders



Magnetic Clutch.

magnetic the opposed fingers of the collar and spider, and a virtual contact is produced. The pulley, which up to this time has been freely turning upon the shaft, is now bound to it by magnetic attraction, but without actual contact. The strength of this union is proportional to the current in the coil. If now a nice adjustment of this current is effected, the power of the clutch may be so governed that it will carry a certain load and no more.

Now, since the resistance to rotation offered by a revolving armature is due to the "drag" produced by the current flowing in its wires, and proportional to it, any rise of current is attended by a corresponding increment of drag. This increased load is too much for the magnetic bond between the fingers of collar and spider to carry. A diminution of armature speed ensues, which is accompanied by the desired reduction of current.

At no time except when every lamp in the circuit is at its least, that is, when the normal resistance of the circuit is greatest, is the speed of the spider identical with that of the pulley. At all other times the spider lags behind the pulley to an extent determined by the resistance of the circuit, viz.: the number of lamps. This regular falling behind of the spider is, however, by no means identical with the variable slip of a belt.

The instances are rare in which a storage battery would be available as a source of current for the clutch coil; it must, therefore, be made a branch of the main circuit to render the dynamo and regulator self contained.

It will at once be urged that the shunt of the main circuit will vary with it and the magnetic power of the clutch will vary accordingly. This necessitates the use of a simple wall regulator consisting of a solenoid with moving core to which is attached a comb of fine wires of successively changing length which, dipping into a mercury cup, close the circuit of the clutch coil and constitute a variable resistance depending upon the depth of immersion in the mercury. This auxiliary apparatus, though entirely impracticable under the high potential of the main circuit, may readily be used to keep constant the slight current of one or two amperes in the clutch coil.

It is anticipated that further experiment will show that the self-induction of the coil will be sufficient to prevent any fluctuations of the current through it, thus doing away with the wall regulator all together.

Among the advantages of this regulator may be mentioned the cheapness of its construction, minimum liability to derangement, and adaptability to any kind of an arc light machine with but a slight amount of labor. The speed of the armature at any time is maintained at just the right degree, and no power is wasted in useless velocity. Furthermore, if the services of the dynamo are no longer required the armature may come to rest without interfering with the speed of the rest of the shafting.

Protection for Power House Engines.

A patent has recently been issued to Mr. T. C. Coykendall, Chief-Engineer of the Kingston, N. Y., City Railway Company, and of the Cornell Steamboat Company, for a device to prevent the closing of the circuit breaker of a dynamo at a time when the current, which would then flow, would endanger the safety of the dynamo engine. The circuit breaker of the dynamo having broken circuit, nothing is known in the power-house of the condition of the line. If the conditions which caused an overflow or short circuit are still present, and the circuit breaker is closed, the shock caused by the instantaneous load, greater than the maximum for which the engine was designed, is likely to destroy the engine.

To prevent this, and also to secure certain other advantages, a resistance equal to about four times the resistance to which the maximum load is due, is connected in series with the terminals of the circuit breaker. When the circuit has been broken the current still continues to flow over this resistance, and if there is an absolute short circuit on the line, the amount of current so flowing is equal to one-fourth the maximum current which the dynamo is designed to furnish. Thus the amount of current flowing in this resistance is greater, as the line resistance is less.

Suppose that one-half the maximum load may be instantly applied to the engine with safety. This condition is attained when the total resistance of the line is equal to twice that to which the maximum current is due. The combined resistance of the line and the shunt joining the terminals of the circuit breaker is then six times the resistance to which maximum current is due. Therefore we see that when the current flowing over the shunt is equal to one-sixth the maximum current, it will be safe to close the circuit breaker. From this explanation it will be evident that this simple piece of apparatus possesses the following advantages:

First. When the circuit is broken, the current flowing over the shunt prevents the instant unloading of the engine; thus there is no tendency for the engine to run away due to failure of the governor to act promptly:

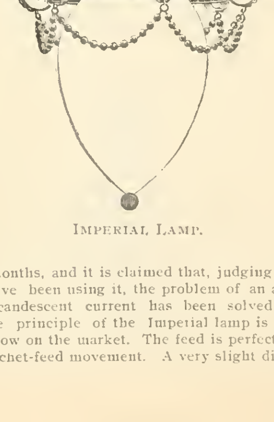
Second. Since the shunt is in series with the station ammeter, by watching the reading of that instrument the attendant knows when it is safe to close the circuit breaker, and thus avoids danger of destroying the engine due to an overload, thrown on instantly;

Third. If a short circuit has been caused by a small wire, that wire is burned off by the current in the shunt, while if circuit breaker is closed it is opened by the overload before the current has time to burn off the wire.

Fourth. By watching the station ammeter the attendant can tell at once when linemen have removed a short circuit. Without this shunt it is necessary for the linemen to go to the nearest telephone, or to send a messenger to the power-house, to notify the attendant that the ground is removed, while with this shunt this is known at once. Thus much time may be saved in the operation of the line.

Imperial Electric Lamp.

The arc lamp we illustrate, manufactured by the Imperial Electric Lamp Co., Postal Telegraph Building, New York, has now been burning in some of the most prominent places in New York for terms varying



Imperial Lamp.

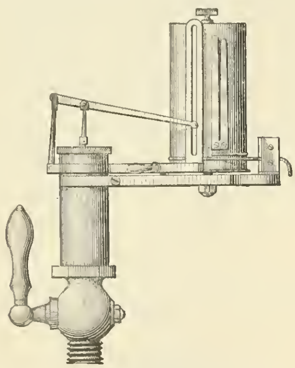
from six to ten months, and it is claimed that, judging from the reports of those who have been using it, the problem of an absolutely steady lamp on an incandescent current has been solved by it. It is also claimed that the principle of the Imperial lamp is entirely different from the others now on the market. The feed is perfectly balanced, and has a positive ratchet-feed movement. A very slight diminution of cur-

rent passing through the carbons (the result of the slightest elongation of the arc), causes the corresponding excess of current to pass through the shunt coil. This coil being thus energized attracts its armature; the circuit, however, is broken by the movement of the armature, and the latter drops back; in this back movement a pawl moves a wheel down one tooth, and the upper carbon is lowered 1-250 of an inch. The feeding is, therefore, so slight each time, that the arc practically does not vary in length at all, with the consequence that the light is absolutely steady. The cut-out embodies also a new principle. Being a chain lamp, the total length is comparatively short for a twelve-hour lamp, being only 26 inches from the top of the lamp to the bottom of the globe, and, for an eight-hour lamp only, 22 inches.

The standard lamp is adjusted to burn two in series, and with a total consumption for both of eight amperes, but they can also be adjusted to burn on any regular direct incandescent current, and to use from 7 to 10 amperes. The company invites the keenest investigation as to the claims of absolute steadiness of light, as well as comparison with other existing lamps.

Valve Setter Indicator.

During the past two years the steam engine indicator has arrived at a state of perfection, beyond which it seems impossible for it to go. While this is unquestionably the result for which every manufacturer is striving, yet there are cases in which this extreme accuracy, attained as it is by such delicacy of construction, serves as a drawback to the use of the instrument. For instance, there is a hesitancy in applying a first-class instrument to a new engine, or one having recently undergone repairs, or changes in the steam piping, on account of the danger of cutting the piston and cylinder by the loosened sand and scale. At such times the question of power is usually not considered and consequently an instrument such as that we illustrate, made by Hine & Robertson, 157 Cortlandt street, New York, will be found to answer the requirements just as well as a better indicator, and can be used with the assurance that if any part is damaged it can be replaced at a merely



INDICATOR FOR VALVE SETTING.

nominal cost. By an examination of the cut its construction can be readily understood. The parallel motion is the well-known slot and the roller device, which is considered sufficiently free from friction to be suitable for an instrument of this class, and it has the advantage of being easily kept in repair. By loosening the small screw shown in the carrying arm, the cock can be screwed in place without rotating the entire instrument, and when in the proper position can be firmly fastened. The drum is very light, and the spring can be adjusted for any speed. As the value-setter is not intended to measure power, the springs are not calebrated, but are stamped with the number of pounds initial pressure they are suitable for.

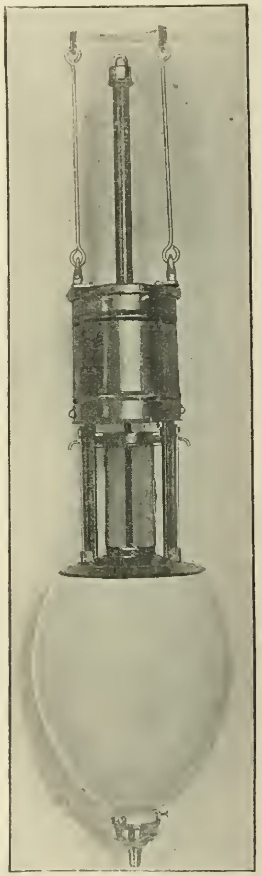
Alternating Current Arc Lamp.

After months of experiment the General Electric Company has finally produced a modification of the '93 Thomson arc lamp adapted to the alternating current, which, it is claimed, places the alternating current for arc lighting on an even footing with the continuous current, whether for indoor or outdoor service.

With the Thomson '93 alternating lamp no external or wasteful resistance is employed; the feeding mechanism is positive, the parts durable and interchangeable, and the regulation perfect. In principle the feeding mechanism is a rack-rod and escapement operated and controlled by an entirely new method. The rack-rod is free to move in both directions without strain on the escapement. The arc is started with none of the "jumping" so noticeably objectionable in the generality of alternating arc lamps. The mechanism is simple in the extreme, and requires no adjustment before installation. All the different styles of lamps, standard, short, focussing, etc., are provided with reflector and spark arrester. The globes may be lowered rapidly and the carbon dust speedily removed.

These alternating arc lamps of a nominal 2,000-cp arc designed for a current of 13 amperes, and are adjusted for that current unless otherwise desired, to be connected in parallel on 32-volt circuits. Each is an absolutely independent unit. The 32 volts can be obtained from the secondary of the transformer, and such transformers wound for 32 volts in the secondary, and of desired capacity will be furnished by the General Electric Company.

It is evident that the great commercial advantages attendant on incandescent lighting by alternating current equally obtain for the alternating arc lamp. If arc lighting alone is to be undertaken the 2,080 or 1,040-volt dynamo feeders run to a central point of distribution; thence the mains carry the current to the transformers, from the secondary of each of which one or more lamps may be operated. In the case of the 2,000-volt primary circuits, there will be but ¼ ampere per lamp,



THOMSON ALTERNATING ARC LAMP.

and in the case of the 1,000-volt primaries ½ ampere per lamp. Thus the line losses are reduced to a minimum.

Four hundred and twenty-five watts is the quota of energy for each standard lamp of 13 amperes, and 32 volts in calculating for the transformer capacity to be installed or permissible number of lamps to be run from transformers already installed, but only partially loaded. In the latter case compensator coils may be used for charging the 52 or 104 volts used for incandescent lighting to the 32 volts required for the arc lamp, the change being effected in the compensator coil with practically no loss of power.

With any alternating current arc lamp the exclusive use of cored carbons designed for alternating current lamps is essential. With the standard lamp 9½"x7-16" or ½" cored carbons are used, giving a life of from nine to ten, or eleven to twelve hours respectively. With the short and focussing lamps, if about the same life is required, 7"x9-16" cored carbons are used. American uncored carbons, or even common cored carbons designed for direct currents, cannot be used, and, moreover, their use would prove very expensive, because of the increased potential which they would require over that required for soft carbons when used for alternating current work.

An Electric Coal Cutter.

We illustrate herewith a new coal cutter that has recently been placed upon the market by The Jeffrey Manufacturing Company of Columbus, Ohio. This company, as is well known, has ever since the advent of coal mining machinery, taken a leading place in the manufacture and designing of this class of machinery.

As will be seen from the illustration, this machine is excellently constructed, its strength, lightness and compactness appealing to the qualified observer at once. As will be noticed, the chain on this machine is inside the stationary bed frame, affording the greatest protection to any one that is working around the machine. The chain belt runs in a perfectly fitting guide, which prevents any undue vibration or side motion, which in turn insures freedom from breakages or fouling of the cutters in the stationary parts of the machine. It will also be noticed that this machine has a peculiarity that is not common to other similar machines, the chain belt traveling in a perfectly horizontal plane, so that only the cutters on the front of the cutter head are attacking the coal.

The motor on this machine has been designed especially for mine service. The fields form a perfectly tight and dust-proof case for the working parts of the motor, and access is obtained to the commutator and brushes by raising a lid in the top of the motor casing, this lid in itself being part of the magnetic-circuit and, when the machine is at work, is held down tightly by the magnetism of the field. The switch is also enclosed in an air-tight box so that any spark from the breaking of the circuit will not be able to reach any dust or gas that may be in the vicinity of the machine at the time. The switch itself is so arranged that the man in starting the machine must move it gradually and slowly to the point where the full current is put on the machine. He cannot leave it at any point half way; if he does so, it will immediately fly back and break the circuit. At the end of the cut the man breaks the circuit by pressing a large button, which frees the starting wheel and lets it fly back rapidly, breaking the circuit at once without producing excessive sparking. The armature of this machine is so designed that any coil can be re-placed inside of half an hour at the mine. This is a great advantage to mine operators, as it saves them the necessity of sending the armature back to the factory to be repaired, with the accompanying delays and expense.

It may be stated in passing that with the exception of four or five pounds, all the material used in the construction of this machine is either hammered wrought iron, cast steel or bronze. The use of such material is expensive, but The Jeffrey Manufacturing Company has learned by long and extensive experience that the work that such machinery is called upon to do, requires the very best quality of material that money can buy, and the highest class of workmanship that can be procured. This machine is considerably lighter than the cutter-bar machine, which has met with such great success in the coal mining districts of Ohio and Pennsylvania. The motor will weigh seven hundred pounds less, which will give a good idea of the relative proportions in regard to the weight of the two machines.

AN ELECTRIC COAL CUTTER.

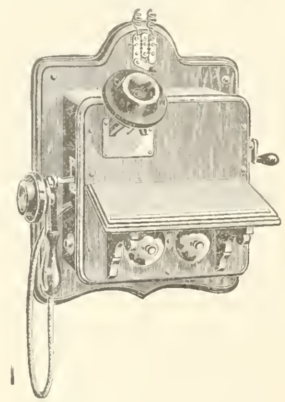
The Phœnix Telephone.

In our issue of last week we referred to a company being organized in New York to give the public a telephone service at $2 per month, and we herewith illustrate the apparatus to be used, which is manufactured by the Phœnix Telephone Company, Produce Exchange, New York.

Both the transmitter and receiver are magneto telephones. The former consists of a powerful horse shoe magnet, which is securely bolted, in an inclined position to the back of the wall case in this instance, the ends projecting beyond the cover. In these projecting ends are two soft iron pins, which pass through a soft metal casting upon which the diaphragm rests and to which is secured the mouth piece. In the cavity of the casting and on the extremities of the soft iron pins, are two bobbins of fine wire, the diaphragm fitting against the ends of the pins. The magneto for operating the call bell, which is within the case, is strongly constructed, unusual mechanical solidity and strength being, indeed, the characteristic of all the apparatus. Its power is such that it will ring clearly through 13,000 ohms resistance.

The receiver consists of a metal handle forming the body of the magnet, having a soft metal pin at right angles at one end, on which the bobbin of wire is placed. The handle is recessed for the conductor cord, the latter, therefore, not being in the way; the hard rubber mouth piece and case is neatly and securely fastened to the handle.

When the telephone is not in use, the receiver hangs on a hook which, in that position, completes the calling circuit, and when taken off the hook, the speaking circuit is switched in. A button to the left

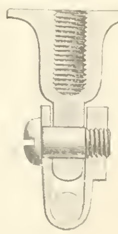

THE PHOENIX TELEPHONE.

of the case switches in the calling circuit when the receiver is at the ear, thus not requiring the hook to be manipulated.

The telephones, magneto and all details, seem to have been designed with more than ordinary care and intelligence, and have a practical appearance that bears out the claim that they are really intended for duty, and which recent tests have demonstrated to be the case. Within the last ten days, we are informed, the most satisfactory results were obtained in talking through 75 miles of ordinary telephone wire, using a ground return. One of the strong points of the telephones is their exceedingly clear and accurate enunciaiton, and the volume of sound is claimed to be not inferior to that of battery telephones.

A New Trolley Sling.

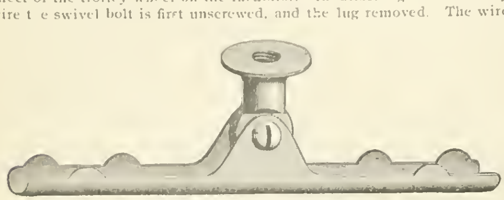
The accompanying cuts show an elevation and sectional view of the Jewell trolley sling, which the Ohio Brass Company, of Mansfield, O.


JEWELL TROLLEY SLING.

has recently made arrangements to manufacture. This cut is especially adapted for trolley suspension on straight line work, where a flexible

support is desired, as is the case particularly where the ordinary pole bracket construction is used.

The lug into which the hanger stud is threaded is swiveled in the body of the ear, so as to admit of an oscillatory motion when the trolley wheel passes under it. This overcomes to a large extent the pounding effect of the trolley wheel on the insulator. In attaching to the trolley wire the swivel bolt is first unscrewed, and the lug removed. The wire



JEWELL TROLLEY SLING.

is then dropped into the groove and the lips bent over it, securely holding it in place. The lug and bolt are then replaced, and the ear fastened on the hanger body. As no soldering or special tools are required, this operation is a quick one, and the result is a strong, flexible support for the trolley wire, which will cause no arc when the trolley wheel passes under. The standard length of the ear is 9 inches. It is made of a composition brass metal, which is best adapted for this class of work.

Judge Lacombe's Storage Battery Decision.

A communication received as we go to press gives a clear statement from the standpoint of the Electric Storage Battery Company regarding the questions involved in the recent decision of Judge Lacombe—an abstract of whose opinion in the case appears in another column in this issue.

The Electric Storage Battery Company, by its president, W. W. Gibbs, says, in this statement, that it has not been enjoined from either manufacturing, selling or using the chloride accumulator, nor has any one been enjoined from purchasing or using chloride cells. The decision of Judge Lacombe merely enjoins the Edison Electric Illuminating Company of New York, from installing chloride accumulators as a part of its central station plant pending the hearing and determination of the question at issue in a suit pending in the Circuit Court of Appeals, upon the grounds that the Edison Company, having simply contracted for the accumulators and not having yet actually installed them, might not be permitted to do so until the questions involved in the litigation should be finally determined in the Court of Appeals, especially as an appeal could be at once taken to and heard in that court on the 30th of October, and an early decision had therein. This, it is claimed, is the view taken by Judge Lacombe, and upon which he acted; and, therefore, Judge Lacombe's decision, it is added, has no other effect or significance, and in no way affects the Electric Storage Battery Company's business of manufacturing and selling accumulators, and was conditioned upon the Accumulator Company giving to the Edison Electric Illuminating Company of New York, a bond in the sum of $20,000, to make good any loss which it might sustain resulting from the delay in installing the chloride accumulators, should the decision of the Circuit Court of Appeals be aganist the Accumulator Company.

The statement further says that the Electric Storage Battery Company has been advised by its counsel and experts, among whom are Profs. Chandler, Barker, Houston and Kennelly, that the chloride accumulator is not an infringement of any patent owned by either the Accumulator Company or the Consolidated Electric Storage Battery Company, and that in their opinion the Swan patent is invalid and expired with the Swan Danish patent in 1888, and that this defense was not passed upon, through Judge Lacombe holding that on the motion for preliminary injunction Judge Coxe's decision was controlling and must prevail until the consideration of the case in the Circuit Court of Appeals, when this defense will be fully heard for the first time, as in the case wherein Judge Coxe sustained the Swan patent no appeal was taken.

The facts of the case are stated to be, that in December, 1890, the Accumulator Company brought suit in the United States District Court of New Jersey, and down to the fall of 1893 no attempt was made by it to press the case, and it was finally abandoned. The Swan patent at that time was owned by the Accumulator Company, although they did not include it in that suit, or after abandoning the latter make any claims against the chloride plate, until last August, when the Edison Electric Illuminating Company selected the storage battery for its central station. Then, instead of bringing suit against the Electric Storage Battery Company, application for a preliminary injunction was made against the Edison Company.

The statement concludes with the assertion that the manufacturing of the chloride accumulator will be continued and batteries furnished under an absolute guarantee, and that the company will at all times sustain its position against threatening companies which proceed against its customers but not against the Electric Storage Battery Company itself.

Reference is made to the decision of the New Jersey Court in last January, denying the motion for any injunction made by the Accumulator Company, since which date the suit has been entirely dismissed.

The Imperial Telephone.

The telephone illustrated herewith is in appearance very much like the ordinary Bell telephone, the most noticeable difference being in the transmitter.

The pattern shown in Fig. 1 is for exchange or private use. Fig. 2 illustrates the Imperial telephone switch hook, which is claimed to be free from the Bell telephone switch patents. The device, as will be seen, is compact and simple. When not in use it locks the telephone, thus avoiding any possible chance for it or the cord to become disarranged. Fig. 3 illustrates a multiple telephone cut-out, which obviates trouble from the instruments being burned out by crosses or by lightning.

Another improved feature of this telephone, which is made by The

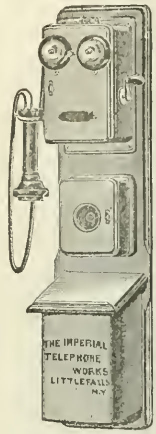


FIG. 1. IMPERIAL TELEPHONE.

Imperial Telephone Works, of Little Falls, N. Y., is the receiver, which has a pneumatic attachment, consisting of an inflated air cushion. This increases the hearing, for the reason that, being yielding, when placed

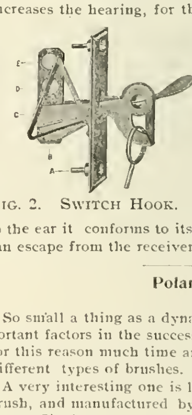


FIG. 2. SWITCH HOOK.

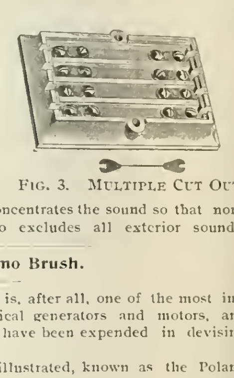


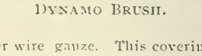
FIG. 3. MULTIPLE CUT OUT.

to the ear it conforms to its shape, concentrates the sound so that none can escape from the receiver, and also excludes all exterior sounds.

Poland Dynamo Brush.

So small a thing as a dynamo brush is, after all, one of the most important factors in the success of electrical generators and motors, and for this reason much time and money have been expended in devising different types of brushes.

A very interesting one is herewith illustrated, known as the Poland brush, and manufactured by Lawrence Poland, of 130 South Second street, Cincinnati. It consists of a bundle of copper wire held in form



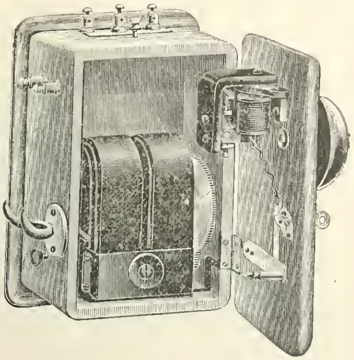
DYNAMO BRUSH.

by a covering of copper wire gauze. This covering is secured by a copper thread cross-stitched through the center of the brush. In this manner each strand is held firmly to the surface of the commutator, and an efficient contact secured. The large number of contacts allow these brushes to carry, without sparking, a current three times as large as the safe limit of a sheet copper brush of the same size. The minute subdivision of the brush also gives the requisite spring without stiffness, and obviates the disagreeable singing noise always produced by sheet copper brushes.

Magneto Signal Bell.

This magneto signal bell we illustrate, is wired for and equipped with a semi-automatic telephone switch, which is claimed to be entirely free from infringement of the patents of the Bell Telephone Company,

The operation of switch is very simple; when the receiver is removed from hook, the button on door of the bell, if pressed, will lock in a spring and stay so until the receiver is replaced on hook, when it automatically returns to its normal position. The contact on the hinges of



TELEPHONE MAGNETO BELL.

the door is kept in good electrical condition by a rubbing action when the door is swung open and shut. The adjustment of gongs is simple, and not liable to become changed through carelessness, as it is only necessary to loosen the screw that holds the standard the gong rests on, when the gong can be adjusted merely by turning. This bell is one of the many telephone specialties of the Manhattan Electrical Supply Company, 32 Cortlandt Street, New York.

General Electric at the Atlanta Convention.

The exhibit of the General Electric Company at the Atlanta Convention will be of an elaborate nature, comprising motors, controllers, other car equipment parts, station switchboard panels, line material, watt-meters, etc.

The G. E. 800 motors will be shown not only in the exhibit proper, but, mounted on cars, will operate over the lines of the Atlanta Street Railway Company. Ample opportunity will be afforded for a close and critical examination of these motors and of the component parts which enter into their construction. The motors, shown in operation, will act in conjunction with the "K" controller, and those interested will be enabled to investigate the merits of the combination. The principle of the magnetic blowout device will also be shown and explained and its action demonstrated. This principle is embodied in all other devices in which electric arcs may occur, such as switches, fuses, lightning arresters, etc.

Several sizes of generator and feeder panels for station switchboards, all of black marbleized slate with the necessary instruments mounted thereon, will also be shown. These panel boards are made in various capacities to suit the requirements of the plant, and have been devised so that the switch boards may be increased in size as the station grows merely by the addition of other panels. The line material exhibited will embody several improvements of an important character, which have become necessary by the increased demands of railroad service.

The Thomson recording watt-meter in its portable form for testing on moving cars will also form an important item of the exhibit, which will be illuminated by means of Thomson '93 arc lamps for railway circuits, connected in series and operating on the railway lines. They have been especially designed for use in power-houses car-barns and elsewhere, where light is desired from the 500-volt circuit.

The exhibit will also comprise samples of underground feeder tubing with models of junction boxes and taps, and amongst the literature which will be distributed will be found a special pamphlet dealing with the application of the three-wire system to street railway work.

The interests of the General Electric Company will be in charge of Mr. W. J. Clark, General Manager of the Railway Department. He will be ably assisted by Messrs. W. H. Knight, Chief Engineer of the Railway Department, Theo. P. Bailey, H. H. Corson, H. J. Crowley, W. B. Potter, H. C. Wirt and A. K. B ylor.

Exhibitors at the Atlanta Convention.

The following is an official list, furnished by the Secretary of the American Street Railway Association, of those who have been assigned space in Machinery Hall, in which to display their exhibits at the Street Railway Convention to be held in Atlanta, October 17, 18 and 19, 1894.

Many other manufacturers and dealers in street railway supplies will have exhibits in the spaces of firms enumerated in this list. Judging by the interest displayed by the street railway equipment and supply men, it is probable that the number of exhibits at the forthcoming convention will be larger than at any previous meeting of the Association.

THE STIRLING CO., Chicago, represented by Thomas Deegan

THE JOHN STEPHENSON CO., N. Y., John A. Thackabery and D. W. Pugh.

THE FIBERITE CO., Mechanicsville, N. Y., H. J. Medbery.

THE SIEMENS & HALSKE CO., Chicago, A. W. Wright.

THE STANDARD RAILWAY SUPPLY CO., Chicago.

J. E. LOUGHRIDGE, Phila., Pa.

THE STERLING SUPPLY & MANUFACTURING CO., N. Y. Mr. Carson.

THE CUTTER ELECTRICAL & MANUFACTURING CO., Phila., Pa., W. E. Harrington, C. E. Bibber.

THE NEW HAVEN CAR REGISTER CO., New Haven, Conn.

E. F. DE WITT & CO. , Lansingburgh, N, Y.

THE JACKSON & SHARPE CO., Wilmington, Del.

THE CENTRAL ELECTRIC HEATING CO., N. Y., E. B. Wyman.

THE BALTIMORE CAR WHEEL CO., Baltimore, Md., J. P. Baker.

THE KELLER PRINTING CO., J. F. Bushe.

THE FITZGERALD-VAN DORN CO., W. T., Lincoln, Neq., Van Dorn.

THE DANIELS STEEL RAILROAD TIE CO., Youngstown, O., T. Burton.

THE LEWIS & FOWLER MFG. CO., Brooklyn, N. Y., L. E. Robert, S. A. Morrell, George Whipp.

THE J. G. BRILL CO., Phila.

THE McGUIRE MANUFACTURING CO., Chicago, Ill., W. A. McGuire, W. J. Cooke.

THE INDUSTRIAL MUTUAL INSURANCE CO., Boston, Mass., Mr. Taft.

THE BASS FOUNDRY & MACHINE WORKS, Ft. Wayne, Ind., P. F. Leach.

THE HARTFORD WOVEN WIRE MATTRESS CO., Hartford, Conn., H. E. Evans, C. G. Smith, N. Y., Thos. C. Millen.

THE MATHER ELECTRIC CO., Manchester, Conn., T. C. Perkins.

THE GENERAL ELECTRIC CO.

THE FULTON TRUCK & FOUNDRY CO., Cleveland, O., W. E. Haycox, Frank A. Rogers.

THE DAVIS CAR SHADE CO., Portland, Me., C. M. Fuller, Geo. F. Card, Reid Carpenter.

THE PAIGE IRON WORKS, Chicago, E. S. Nethercut, A. W. Paige.

THE CONSOLIDATED CAR HEATING CO., Albany, N. Y., N. H. Ranson, J. F. McElroy.

THE R. A. CRAWFORD MANUFACTURING CO., Pittsburg, Pa., R. A. Crawford, C. N. Wood, C. J. Mayer.

THE WADHAMS OIL & GREASE CO., Milwaukee, Wis., E. A. Wadhams, G. A. Streeter.

THE PECKHAM MOTOR TRUCK WHEEL CO., N. Y., E. Peckham.

THE OHIO BRASS CO., Mansfield, O., C. K. King.

THE GRAHAM EQUIPMENT CO., Boston, Mass., J. H. Graham, G. S. A. Gardiner, C. O. Lenz.

THE CREAGHEAD ENG. CO., Cincinnati, O., T. J. Creaghead, G. R. Scrugham.

THE MICHIGAN ELECTRIC CO., Detroit, Mich., J. E. Lockwood.

THE ROCHESTER CAR WHEEL WORKS, Rochester, N. Y., F. D. Russell, G. C. Morse.

THE INTERNATIONAL REGISTER CO., Chicago, A. H. Englund.

THE R. D. NUTTALL CO., Allegheny, Pa., F. A. Estep.

THE GENETT AIR-BRAKE CO., Chicago, Ill., E. J. Wessels, G. S. Lee, Samuel P. Ferree.

THE WALKER MANUFACTURING CO., Cleveland, O., F. Billings, W. H. Bone, S. H. Short, H. McL. Harding, Ed. Kobler, J. M. Atkinson, B. M. Barr, H. A. Darrall.

THE BREESE & MANSFIELD CO., Philadelphia, Pa.

THE H. W. JOHNS MANUFACTURING CO., N. Y., W. F. D. L. Crane, H. G. Issertel, J. W. Perry, E. B. Hatch, H. Luscomb.

WESTINGHOUSE ELECTRICAL & MANUFACTURING CO., Pittsburg, Pa.

CLAUDE ESTES, Esq., Macon, Ga.

NATIONAL LOCK WASHER CO., Newark, N. J.

AMERICAN RAILWAY MAINTENANCE SYNDICATE, New York.

CHARES L. CORNELL, Hamilton, O.

T. J. THOMAS, Knoxville, Tenn.

JAMES W. NAGLE, "The Car," Philadelphia, Pa.

STILWELL-BIERCE & SMITH-VAILE CO., New York.

YOUNG LOCK NUT CO., New York.

A. HAAS & R. E. WATSON, Atlanta Ga.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 12, 1894.

DETROIT ELECTRICAL WORKS stock is about to emerge from its long spell ol inactivity. A meeting of stockholders is to be held in Detroit on the 15th inst. to determine on a plan of reorganization and some dealings may be had in the present stock to settle its value.

BELL TELEPHONE stock is down this week on revived reports of new competition. Mayor Schieren of Brooklyn has approved the bond of the New York and Eastern Telegraph and Telephone Company for $50,000, and it is feared that this concern may develop considerable opposition in the profitable metropolitan district.

ERIE TELEPHONE has been the feature of the Boston market. New York houses like T. W. Myers & Co., and others prominent in "arbitrage" business, being prominent buyers ot the stock. It is intended to list Erie Telephone on the New York Stock Exchange, and quite a business will then be done in the stock tn the two markets. The company owns a controlling interest in three telephone corporations, and has paid 4 per cent. annual dividends for years, though its present earnings are at the rate of 6 per cent. per annum.

THE ELECTRICAL STOCKS, by reason of the prominent part "Industrials" continue to play in the stock market, still contribute a good deal to whatever activity is noted these days in Wall street. With all conditions warranting bullish sentiment, trading, however, continues mainly on the bear tack, and therefore, has no real significance when quotations fail to reflect the statements repeatedly made in these columns of reviving trade. The dividend payments continually reported and herein noted tell a story quite contrary to any falling quotation that the appended table may record.

EDISON ILLUMINATING (New York) stock was barely affected by the injunction granted this week preventing it from using the batteries made by the Electric Storage Battery Company, though the stock of the latter company fell in Philadelphia from 33 to 23 on the news of the injunction, though it afterwards again rose to 30. The Edison people are not much disturbed over the matter. The patent in question expires next May, and the batteries will be used in the meantime under bond until the litigation is settled. Treasurer Joseph Williams reports earnings for September as follows: Gross, $101,030; increase, $14,099; net, $48,606, increase, $4,411. For the nine months ending September 30, the company reports: Gross earnings, $967,389; increase, $115,169; net earnings, $502,964; increase, $118,094. This is very flattering in view of general business conditions.

WESTINGHOUSE ELECTRIC, preferred and common stocks are a little higher. The feeling on these shares is more bullish than ever. At the present rate of business the company is making a tremendous profit on the capital invested. If it is making so much money now, there is no calculating how large profits it will earn when it moves into the new works, whose capacity is much above that of the present factories, while the arrangement of the plant is such that it will result in a saving on the cost of manufacture of from 20 per cent. to 25 per cent. At present the old factories are working up to their fullest capacity, and many orders are being taken subject to delay. The Westinghouse people claim that they are now doing a gross annual business nearly equal to that done by the General Electric Company, and assert just as confidently that their margin of profit is much greater. One-third of the present manufacturing business of the Westinghouse Company is in the lighting department; the new incandescent stopper lamp is meeting with continued favor in every quarter and its introduction has proved a most gratifying success. The prices obtained in all new business are right up to schedule figures. In view of these official statements, it is not to be wondered at that the investment demand for Westinghouse issues continues unabated.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	102	102¼
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	37½	38
General Electric pref	100	70	72
Interior Conduit & Ins. Co.	100	25	35
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35½	36
* " " pref	50	52	53

BONDS.

	Par.	Bid.	Asked
*Edison Electric Ill., New York	1,000	107⅛	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
*American Bell Telephone	100	199½	200
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	105	110
*Commercial Cables	100	125	145
Erie Telephone	100	55½	56
Gold & Stock Telegraph	100	102	105
*Mexican Telegraph	100	180	190
New England Telephone	100	67	69
[illegible]tal Telegraph-Cable	100	50	60
*Western Union Telegraph	100	87½	88

* Ex-div.

THE WESTERN UNION TELEGRAPH COMPANY made public this week the annual report for the year ending June 30, 1894. After paying dividends there is a surplus of but $120,815, as compared with a surplus in 1893 of $1,930,841, in 1892 of $2,158,386, and in 1891 of $1,364,758. The balance sheet shows the possession of real estate worth $4,979,533 and stocks and bonds worth $7,296,679. There was an increase in the bonded debt of $25,311. As compared with 1893 there was a reduction in gross revenue of $3,125,787, a saving in expenses of $1,422,235 and a loss in net profits of $1,703,733. Dividends, however, were not reduced. The stock closes for the week at a trifling loss due to this showing.

GENERAL ELECTRIC has declined somewhat this week, yet its prospects are no less bright than they were a week ago. There is, notwithstanding, sentiment in Wall street, and, when that sentiment is disposed to be bearish, prospects and developments, no matter how favorable, count for naught. Very little trading has been done in the stock. What has been done has been for the bear account and has hardly served to more than increase an already unwieldy short interest. This, at present, is the biggest bull factor on the stock, for, should the bear clique be once scared, it will not take much buying to make them tumble over one another to cover short contracts. One obstacle to a big advance lies in the large amount of floating stock. If two or three large owners of the common stock could be induced to lock up their holdings for a year, the available supply would be greatly reduced, and a little buying would cause large advances. Of course, this would after a while restrict trading, but prices would then be on a higher level, and speculation would be based on a more profitable basis. Reports of new business continue in the same cheerful strain. There has sprung up within the last few weeks a tremendous boom in new electric street railway enterprises, and the General Electric Company is making strenuous and often successful efforts to secure its due share of the profitable contracts for equipping these new roads and on a cash basis. The days of taking stocks and bonds in new companies for payment of apparatus are happily gone.

NEW INCORPORATIONS.

THE NOWOTNY ELECTRIC COMPANY, Cincinnati, Ohio, capital stock $25,000, has been formed to manufacture and deal in electrical goods and supplies. L. R. Keck, John S. Nowotny, A. G. Corre, Claude Ashbrook, and H. D. Emerson.

THE KEYSTONE ELECTRIC STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock $180,000, has been formed to construct and operate an electric street railway. Thos. W. South, Chas. P. Tomlinson, Philadelphia, and Frank F. Bell, Bristol, Pa., are interested.

THE HESTONVILLE & OVERBROOK PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $5,000, has been incorporated to construct, maintain and operate an electric railway. John Hopkins, Isaac Blum and Simon J. Martin, of Philadelphia, are the promoters.

THE THOMPSON-BROWN ELECTRIC COMPANY, New York, capital stock $25,000, has been formed to deal in all kinds of electrical machinery, apparatus, etc. George Thompson, Oyster Bay, L. I.; M. W. Brown, Hyde Park, Mass.; and Ernest F. Ayrault, New York, are the promoters.

THE FARADAY ELECTRIC AND CHEMICAL COMPANY, Kittery, Me., capital stock $150,000, has been incorporated to manufacture and deal in electrical and chemical machinery. W. W. Jacques, Newton; Belle L. Ruggles, Reading; and James H. Flanagan, Boston, Mass., are interested.

PHILADELPHIA & NESHAMINY ELECTRIC RAILWAY COMPANY, Philadelphia, capital stock $75,000, has been formed to construct, maintain and operate an electric railway. The incorporators are Thos. W. South, Tacony; Chas. P. Tomlinson, Bustleton, Philadelphia, Pa., and Frank F. Bell, Bristol, Pa.

THE INTERSTATE FUEL, LIGHT & POWER COMPANY, Chicago, Ill., capital stock $6,000,000, has been incorporated to manufacture and sell gas and fuel, light and power, and materials, machinery and appliances therefor, and for the distribution of the same, etc. J. W. Keneval, J. I. McCauley, Charles Rose, Otto Schauzenbach and Jesse A. Baldwin are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Oct. 12, 1894.

H. WARD LEONARD has removed his offices from 136 Liberty street to the Edison Building, 44 Broad street.

THE RAPID TRANSIT COMISSIONERS, at their meeting on October 10, received an exhaustive report from its chief engineer, W. B. Parsons, on the underground transit systems ot European cities, to which he had devoted a summer of study and investigation. In regard to motive power, the conclusions of the report are that an underground railway operated by steam, even with the most approved system of mechanical ventilation, would be intolerable to the people of the city of New York, and that a railway with a speedy, frequent service can be operated successfully and economically by electricity.

CANADIAN NOTES.

OTTAWA, Oct. 8, 1894.

GALT, ONT.—The directors of the Galt and Preston Electric Street Railway are applying to the Legislature for power to increase the capital stock from $50,000 to $100,000; also to apply for Letters Patent, extending its powers to the construction and operation of a line of street railway from Preston through the Township of Waterloo to Hespeler.

TORONTO.—The Board of Works has given the Georgian Bay Aqueduct Company the right to lay mains on the streets of the city to supply electric heat, light and power; the only condition attached is that the maximum charge for electricity in any form shall be one cent per horse power per hour.

It is likely a provision will be inserted in the charter requiring 5 per cent. of the gross earnings to be given to the city.

OTTAWA, ONT.—There has been some talk about running the Canadian Pacific Railway trains in the West by electric power, got from the water shores in the Rocky Mountains. Asked as to what the real condition of affairs is, Sir William Van Horne said: "Yes, that has been suggested. There is no doubt that it could be done and done well. The only question of any importance is this: Can we put out the necessary capital for the works and expect the proper return by way of interest? We are considering that question, rather each director for himself than as a Board. For myself I don't mind saying at once that I don't see that the scheme is financially a practicable one. Certainly not at present."

HULL, QUE.—Hull is to have an electric street railway and an electric light system. An offer was made at the Hull council meeting last evening, considered, and before midnight adopted. It is a joint stock company that will engage in the undertaking, of which T. Vian is the leading spirit. The company will bind itself to begin the construction of an electric line that will give satisfactory service to Hull and connect Hull with Gatineau Point, Ironsides and Aylmer within three years. It will have thirty years franchise, during which time the city shall not grant similar power to any other company. The company agree to expend $15.000 the first year and at least $5,000 each year following until the line is completed.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, October 4, 1894.

THE BRUSH COMPANY.—The results of the year's work of the Brush Electrical Engineering Company is an improvement upon that of the Electric Construction Company to which I recently referred. Notwithstanding what must be termed its inflated capital of £575,000, the Brush Company has succeeded in paying, for the year ending June 30, a 5 per cent. dividend on its ordinary shares, notwithstanding that in front of these shares there are 90,000 £2 6 per cent. preference shares, and 125,000 of 4½ per cent. debenture stock. The Company, however, still appears to receive a large portion of its income in shares of subsidiary companies; a mode of procedure, which, if persisted in, will certainly result in reduced dividends.

ELECTRIC METERS.—It is always considered in this country an unprofitable proceeding to have the accuracy of one's gas meter tested, since the invariable result is that it is certified to register several per cent. *too low*, and therefore the net result is that the suspicious customer has to pay the cost of the test, and to receive from the gas company a meter which does not kindly undertake the task of keeping down his gas bill. Electric meters are apparently following in the same path. In the report recently published by the surveyor of the Chelsea Vestry he states that only one application was made to that authority to test a customer's electric meter, with the result that it was found to register 8¾ per cent. too low. The electrical company, on receiving this information promptly supplied the dissatisfied customer with a more accurate recorder of his consumption.

News of the Week.

TELEGRAPH AND TELEPHONE.

UHRICHSVILLE, O.—Geo. T. Fleming, of Dennison, has receievd a franchise to complete a telephone system.

BROOKLYN, N. Y.—The bonds of the New York and Eastern Telegraph & Telephone Co., which recently got a franchise from the Brooklyn Aldermen, have been approved and it will begin work at once.

ALBANY, N. Y.—The Standard Telegraph & Telephone Company has been incorporated with a capital stock of $50,000. The directors are James H. Mills, Asa C. Bissell, Chas. J. Gidden and Abnor S. Adams, of Lowell, Mass.; Arthur L. Andrews and A. Page Smith of Albany, and others

LITTLE FALLS, N. Y.—The work of constructing the new line of the Inter-State Telephone Co., of which Victor Adams is president, is about to begin. Leroy T. Carver, of this place, has the contract. The line will extend from Little Falls to Canajoharie, connecting the towns with St. Johnsville and Fort Plain.

ELECTRIC LIGHT AND POWER.

NORWICH, CONN.—The city is agitating the question of erecting an electric light plant.

AMERICUS, GA.—The city is considering the erection of an electric light plant. Address the Mayor.

FREDERICKSBURG, VA.—A committee is obtaining estimates on the cost of an electric light plant for the city. Address the Mayor.

NEOSHO, MO.—The Neosho Electric Light Company will erect a plant if the city grants a franchise. The machinery is all contracted for.

PENSACOLA, FLA.—The Pensacola Electric Light & Power Company has added a 650-light alternator, purchased from the General Electric Company.

PALATKA, FLA.—The Palatka Electric Light, Power & Supply Company has closed with the General Electric Company for two 25-kw direct current dynamos.

ST. LOUIS, MO.—The St. Louis Underground Service Company has submitted to the B. P. W. supplemental plans for conduit connections in several streets.

NEW ORLEANS, LA.—The Louisiana Electric Light Company, at a meeting to be held in New York shortly, will consider the erection of a power-station for electric car service.

PENSACOLA, FLA.—It is said that Mr. E. A. Sweet, present superintendent of the Pensacola Electric Light Company has leased the plant for a term of years and that it will be put in first-class shape at an early date.

SEATTLE, WASH.—The Diamond Ice & Storage Company has filed its acceptance of the 25-year franchise to lay pipes, wires and conduits for distributing steam, hot water, gas and electricity for heat, light and motive power.

BUFFALO, N. Y.—A building is to be erected at the S. W. corner of Elliott and Carroll streets by Wells, Williamson & Company, which will use electric power from Niagara Falls Mfg. Co. for manufacturing purposes. Metzger & Greenfeld are the architects.

LYNCHBURG, VA.—The Light Committee of the City Council held a meeting and decided to report in favor of accepting the proposition of the Electric Company, with some slight changes. The company owns the car line, the electric plant and water power at Rensens.

ALLEGHENY, PA.—The Westinghouse Electric & Manufacturing Company is about to establish another large industry in this section. The company will quickly build a 14-pot glass furnace on Lacock street, Allegheny, and is going into the business of incandescent lamp making on an extensive scale.

FREMONT, OHIO.—The city's contract for electric lighting will expire the first day of January, and the light committee was instructed to advertise for bids for lighting the city with electricity from that date for a period of five to ten years. The Council hopes to be able to secure cheaper and better lights.

GRAND RAPIDS, MICH.—Sealed proposals will be received until October 27, 1894, for lighting the city of Gand Rapids with electricity by means of 280 arc lamps of 2,000-candle power each, distributed on towers and individually. Joseph Emmer, W. T. Johnson and O. A. Ball are the Committee on Lamps.

SACRAMENTO, CAL.—The contracts for the Folsom-Sacramento transmission plant have finally been signed, and the work of construction will be pushed with all rapidity. Messrs. Hasson & Hunt, of San Francisco, are the advisory engineers, and the General Electric Company the contractors for machinery and construction.

ELBERTON, GA.—The city contemplates erecting an electric light plant and water-works system, and a mass meeting of citizens has been held in regard to an issue of bonds for $5,000. The Council has been ordered to call an election within 30 days to decide as to the issue of bonds. Address the Mayor or W. B. Henry, Clerk of the Council.

BRADFORD, PA.—The committee to inquire into the construction of an electric light plant reported favorably, with estimates for a sufficient plant for $25,000, ample to run 150 arc lights of 2,000-candle power. A resolution was offered asking the Mayor to issue a proclamation for a vote on some bonds to erect the plant, the vote to be taken at the February election.

MT. MORRIS, N. Y.—Several notes which have appeared in this department in regard to an electric lighting plant to be established at Mt. Morris may have conveyed a wrong impression in regard to the success of the company now possessing franchise there—the Mt. Morris Illuminating Company. The plant referred to in the notes, however, is the one to be installed for lighting the buildings of the State Epileptic Colony, the satisfactory service of the Illuminating Company precluding any thought of establishing a rival to it.

THE ELECTRIC RAILWAY.

ST. GEORGE, S. I., N. Y.—It is believed that Mr. Howard Carroll intends to build a trolley road on Staten Island.

GENEVA, N. Y.—It is reported that work of constructing the Geneva & Waterloo Electric railway is very soon to begin.

MOBILE, ALA.—The Mobile Light & Railway Company has closed a contract with the General Electric Company for a 120-kw monocyclic generator and an arc dynamo.

PLATTSBURGH, N. Y.—Mr. Norton contemplates the construction of a street railway system between Hotel Champlain and the Normal School, with numerous branches.

SHERMAN, TEXAS.—It is stated that the College Park Rapid Transit Company has sold its electrical railroad to a syndicate, which will build ten miles of additional road.

NEW HAVEN, CONN.—The petition of the Manufacturers Railroad Company for permission to operate a road by electricity through James street was referred to the committee on streets.

WASHINGTON, D. C.—A new street car line is badly needed. The route would be out 17th street to Lowell on Park street, and along Lowell to the entrance to the "Zoo" Park.

COUNCIL BLUFFS, IOWA.—The Council Bluffs Manawa Electric Railway Company received a franchise from the Manawa Council for right-of-way over all the streets and alleys in the town.

WILMERDING, PA.—The borough council of Welmerding has granted right of way through the borough to the Turtle Creek Valley Electric Railway Co., to connect Wilmerding and McKeesport.

PHILADELPHIA, PA.—A car stable and power house, 100x500 feet in size, will be built for the People's Passenger Railway Company, near Carpenter Station, Mt. Airy, by Contractor Chas. McCaul.

PIKESVILLE, MD.—The Pikesville, Reisterstown & Emory Grove Railway Company has secured the right-of-way to construct a single track electric railway on the turnpike from Pikesville to Reisterstown, a distance of about 12 miles.

PORT BYRON, N. Y.—The electric road from Port Byron to Auburn now seems to be an assured fact. Eastern capitalists have taken hold of the mattter and have looked over the proposed route. Work will probably begin in the spring.

PITTSBURG, PA.—The Committee on Corporations of the Council recommended an ordinance granting right-of-way to the Pittsburg & Birmingham Passenger Railway to extend its line on Carson street east from the present terminus.

HACKENSACK, N. J.—The proposition of the Bergen Turnpike Company to build a trolley line in Hackensack has been disturbing the people. The town authorities purpose contesting the right of the company, which is expected to make a sharp contest.

DOYLESTOWN, PA.—William Jenks, Marshall S. Lynch, Robert C. Fulton

and Samuel A. Hamilton, of the Bucks County Trolley Company, have made application for a charter for an intended corporation to be called the Delaware & Schuylkill Traction Company.

SYRACUSE, N. Y.—The contract for lighting the city is held by the Syracuse Electric Light and Power Co. and will not expire until April 21st of next year. Several of the officers of the present administration declare that the rate of 30 cents per lamp is exceedingly low.

CORTLAND, N. Y.—At a meeting of the directors of the electric railroad, the contract for erecting the new power house was awarded to J. S. Ball. Ground has been broken. The power-house will have four 150-hp engines of the compound condensing type and four 150-hp power boilers.

JAMAICA, L. I., N. Y.—The Long Island Electric Railroad Co. and the trustees of the village of Jamaica have at last come to an agreement as to the terms of a franchise asked for by the company to operate an electric railroad on certain streets of the village. The president is A. R. Hart.

PHILADELPHIA, PA.—Paul R. Smith, of Philadelphia, representing a number of Philadelphia capitalists, is negotiating for the purchase of the stock of the Perkiomen & Reading turnpike, with the view of building an electric railway line from Philadelphia to Reading. The price offered for the stock is $81 000.

BATAVIA, N. Y.—A new electric railroad on the bicycle system is to be built from Batavia to Lake Side, N. Y., passing through Medina and Waterport. It is said that the new company will construct a dam at Oak Orchard Creek, from which will be obtained the water power for the generation of electricity with which to propel the cars.

MIDDLETOWN, CONN.—It is now definitely stated that the electric road pormised so long is to be commenced at once. Isreal A. Telsey, of New Haven, and Mr. Pond, of New York, who owns the electric road in New Haven are now the owners of the controlling amount of stock in this road. The capital stock is $50,000.

PROVIDENCE, R. I.—The Council has granted permission to the Providence Cable Tramway Company to substitute electric motive power for its present cable system. The change includes the adoption of a counter weight on the steep grade of College street, the descending cars pulling up a weight which assists to pull up the ascending cars.

BALLSTON, N. Y.—Stephen C. Nedbery, cashier of the First National Bank, and Herbert C. Westcott, secretary of the Ballston Electric Light & Power Company, have applied to the trustees for a franchise to build and maintain an electric railway within the corp rate limits of Ballston Spa, the objective point being Rock City Falls. If granted the road will be built by June next.

NORFOLK, VA.—The Norfolk & Atlantic City Terminal Co., of which Mr. Joseph T. Allyn is president, has submitted a petition and ordinance to the Council asking permission to run a railway, whose motive power will be either electricity or horses, through several of the streets of the city. The whole matter was referred to a special committee consisting of Messrs. Sheldon, Brickhouse and Collins.

SOUTH ORANGE, N. J.—Petitions were received by the South Orange Township Committee from street railway companies, asking for franchises to operate a trolley line on Springfield avenue, between Irvington and Millburn. The New York & Philadelphia Traction Company's application was laid on the table, being reported as not properly presented. The Northern New Jersey Company's application was received and will be considered at a public meeting October 25.

LANCASTER, PA.—At a meeting of the Council Mr. Dinan presented an ordinance, which was referred to the Street Committee, granting the Lancaster City Street Railway Company the right and privilege to make extensions of its railway tracks and to operate motor cars thereon, and granting permission to the Lancaster Railway Company and the Lancaster & Terre Hill Railway Company the right to run their cars over the tracks of the Lancaster City Street Railway Company within the city limits, and to erect and maintain poles on certain streets.

Miscellaneous Notes

MR. JOHN BECK INGHAM, the well-known Philadelphia contractor, was married to Miss Emma L. Stephens, on October 10, at the bride's residence, Fairmount avenue, Philadelphia.

PATENT LITIGATION.—The Westinghouse Electric and Manufacturing Company has sued the Fort Wayne Electric Company for infringing since December 12, 1890, a number of its patents.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES will inaugurate its 1894-95 course in the Department of Electricity on October 15, with a lecture on "Electricity and Its Applications in the Arts and Sciences," the first of eight illustrated lectures by Prof. Anthony, to be delivered in the lecture room of the Edison Electric Illuminating Company, 360 Pearl street, Brooklyn. A special course in electrical technology, with laboratory exercises and practical work, will be given at the same place; there will be 24 of these latter, the subscription to be $8.00 for the course.

THE FRANKLIN INSTITUTE, Philadelphia, announces the following programme of lectures on electrical subjects for the season 1894-95: Friday, Nov. 30, Mr. Louis J. Matos, Chemical Engineer, Chemist to the Falls of Schuylkill Carpet and Plush Mills, Philadelphia, "The Application of Electricity to the bleaching of Textile Fibres"; Friday, Feb. 1, Prof. Joseph W Richards, Ph. D., Lehigh University, Bethlehem, Pa., "Recent Progress in Electro-Chemistry"; Friday, March 15, Mr. Alexander Jay Wurts, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., "Lightning Arresters"; Friday, March 22, Mr. A. E. Kennelly, F. R. A. S., Philadelphia, "Submarine Telegraphy"; Friday, March 29, Mr. Thomas Commerford Martin, New York, "Niagara on Tap".

THE NATIONAL SCHOOL OF ELECTRICITY has just established headquarters in New York City at the Decker Building, Union Square. Classes will be organized at several points in the city, as well as in Brooklyn and surrounding towns. Another office has been opened in Philadelphia in the Drexel Building, and within a few days a Boston office will be opened. From the Western office at Chicago classes have been organized in seven Western and Middle States, aggregating in membership something over fifteen hundred students. Considerable misconception seems to prevail in regard to the teaching faculty of the National School of Electricity, owing to an ambiguity in the published announcement. Tesla, Edison, Carhart, Anthony, Ryan and other names eminent in electrical science are announced simply as the "Faculty," and several youths who have called at the office of The Electrical World for information were under the impression that these gentlemen would be the actual teachers, which also seems to be the impression of some newspaper writers. We understand that the faculty named is an honorary body, though some of its members will prepare the lesson sheets in departments assigned to them.

TESLA AND THE NIAGARA PLANT.—A writer in the current number of "McClure's Magazine," in an article on "The Capture of Niagara," ascribes the success of the efforts to interest capital in the development of electrical power from Niagara Falls to Nikola Tesla. In regard to the many problems at issue the article states, after paying a tribute to Lord Kelvin, Dr. Sellers and Clement Herschell, that "the problem was, perhaps, not wholly solved in theoretical demonstration until Nicola Tesla, that illuminating wizard of electricity, persuaded these capitalists that he had discovered and, in great measure, perfected mechanical appliances which would make it possible to deliver the electric current, under complete control, and without costly loss from waste, a long distance; certainly as far as Buffalo and Rochester, and, as he himself firmly believed, as far as Albany, three hundred miles away. Mr. Tesla also has faith that, with the improvements suggested by experience, it will be possible by and by to deliver the current at fairly competitive prices as far away as New York city on the east, and as Cleveland and other of the greater towns in Ohio on the west. He has assured the company that, by means of inventions and scientific application of newly discovered principles which he has been able to make, it will be possible to convey the current without any very great loss by induction or leakage, and under absolute control, by the use of certain transformers, as far east as Albany. It is Mr. Tesla's opinion that this current can be sufficiently utilized even to propel vessels from Albany to New York. The capitalists have faith in him. The scientists believe that he is right. The city of Buffalo is persuaded that it is so, and already contracts for the delivery of as much as ten thousand horse power to the city have been made." The same writer says that "we cannot know, in fact, whether the electric current can be delivered with commercial profit to any considerable distance from the plant until the turbine wheels are actually started, their colossal power is delivered to the dynamos, and, after being by them converted into electricity, is conveyed thence to the testing points. The scientific world is awaiting these experimental tests as it awaited the first flashing of the message through the Atlantic cable; and the world of commerce and manufacture is awaiting them with no less interest."

Trade and Industrial Notes.

M. E. AUSTIN, formerly of the Knapp Electrical Works, Chicago, has been appointed western agent for Holmes, Booth & Haydens and the Safety Insulated Wire and Cable Company.

MESSRS. G. M. ANGIER & CO., New England contractors for the Mather Electric Company, have removed their offices from 116 Bedford street to 64 Federal street, Boston, Mass., where they have secured a suite of offices far more suitable for their business than at the old quarters.

MR. W. J. MAC CONNELL, formerly of Baltimore office of the General Electric Company, has resigned his position with that company to take the Eastern agency of the American Electrical Manufacturing Company, of St. Louis, with headquarters in Havemeyer Building, 26 Cortlandt street.

W. A. HALLER, First National Bank Building, Pittsburg, Pa., informs us that he was the contractor for the plant on board the coal boat "Robert Jenkins" described in The Electrical World of September 22. We regret that the name of Mr. Haller was inadvertently omitted from the article.

THE DETROIT MOTOR COMPANY, 1,343 Cass avenue, Detroit, Mich., sends us a handsomely executed catalogue devoted to the well-known Detroit motor. Different parts of the motor are illustrated by excellent wood cuts, as well as the automatic switch used with them, which entirely obviates any possibility of a burn-out.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the closing of a second contract with the Hartford & West Hartford Horse Railway Company, Hartford, Conn., for two of their 180-kw railway generators with new Mather station equipment, the first generator, which was installed a few weeks ago, having given great satisfaction.

THE P.-W. STORAGE BATTERY COMPANY, of which R. Parsons, Son & Co., 173 Euclid avenue, Cleveland, Ohio, are general agents, has issued a 16-page pamphlet descriptive of the P.-W. storage battery and its uses. Illustrations of the battery and accessories are given, and the advantages of the Warwick plate and its applications are enumerated at length.

THE COOPER-ROBERTS COMPANY, Mt. Vernon, Ohio, reports the following recent sales of its high speed automatic engine: 40-hp to Barkhurst & Craven, Dillonvale, Ohio; 100-hp to Morris Coal Company, Sand Run, Ohio; 80-hp to Southwestern Virginia Improvement Company, Pocahontas, Va.; 80-hp to Chagrin Falls Electric Light Company, Chagrin Falls, Ohio; 150-hp to the Jeffrey Manufacturing Company, Columbus, Ohio; and one 40-hp, one 80-hp and one 110-hp for the Odd Fellows Hall, Philadelphia, Pa. T. T. Burchfield & Co., 55 North Seventh street, are the Philadelphia representatives of the Cooper-Roberts Company.

EUGENE MUNSELL & CO., 218 Water street, New York, have issued their new price list of electrical mica, arranged in a very convenient form. Each different size and grade is accompanied by a telegraph code word, of which there are over 300. In addition to the ordinary cut mica, we find India and amber sheet mica, stamped solid sheet mica segments for commutators, in fact, mica for every conceivable electrical use.

THE WESTERN ELECTRIC COMPANY, Chicago, has just issued a catalogue of street railway supplies comprising 98 large pages of descriptions and illustrations of every variety of line, power-house and motor material. Each item has a telegraph code letter affixed, thus greatly facilitating ordering in an emergency. The book is well printed on an extra quality of paper, and should be on the desk of every street railway superintendent and purchasing agent.

THE FIBERITE COMPANY, Mechanicsville, N. Y., will have two handsome exhibits of its well-known Medbery insulation at the forthcoming Street Railway Convention at Atlanta, one in the private parlor of the Mason Electric Company in the Hotel Aragon, and the other in the convention hall. The exhibits will be in charge of Messrs. H. J. Medbery, of The Fiberite Company; W. R. Mason, of Chicago, and F. H. Stacy, of the Hubley Manufacturing Company, of Lancaster, Pa.

A. O. SCHOONMAKER, 158 William street, New York, in a recent circular calls attention to the superior qualities of India solid sheet mica. To have the best and most satisfactory results mica should be used in its native condition, that is, in the solid sheet as it is mined, and it is only in this form that Mr. Shoonmaker handles it. The mica he sells comes direct from the original sources in India, and is perfectly free from iron, thus rendering its non-conducting properties of the very highest order, while it splits even throughout with a uniform smooth cleavage.

EDGAR ALLEN & CO., (Limited), Imperial Steel Works, Sheffield, England, send us a large-page pamphlet containing reports and permeability curves by Profs. Ewing and Jameson and Mr. Gesbert Kapp, relating to Imperial dynamo magnet steel castings. A number of curves to a large scale are included, showing the extraordinary good permeability and hysteretic qualities of this material. A working induction of 18 kilogausses can be reached and the ampere-turns for all working inductions are less than for wrought iron. The numerous curves will be found of value for comparative purposes.

THE IMPERIAL ELECTRIC LAMP COMPANY, 253 Broadway (Postal Telegraph Building), New York, has received flattering evidence of the efficiency of the Imperial arc lamp. The use of it by, and the recommendation of, such companies as the Royal and Hartford and Underwriters Insurance Companies, such hotels as the St Cloud, Renaissance and Barrett House, such a printing house as the Fox, and such a dry goods store as that of Ehrich Bros., must mean more than usual in these days of competition and strife after superiority. The Imperial Company claims that only after a most exhaustive competition did it succeed in capturing the above business.

THE LOUISVILLE ELECTRICAL WORKS, located at No. 148 Fifth street, Louisville, Ky., is a new concern embarking in business as manufacturers of electrical and mechanical specialties, repairers of electrical apparatus and machinists. Mr. Campbell Scott, formerly president of the Southern Engineering Company, is the general manager, and they have fitted up a model factory in a large three-story building with a fine equipment of modern machinery, and are already working a full force of competent men. Besides doing all classes of electrical repair work, building and refilling commutators, etc., they will make a business of model making, manufacturing special apparatus, devices and appliances to order, and brass working. They are desirous of hearing from inventors who have practical, useful and saleable specialties which they desire manufactured.

THE MICA INSULATOR COMPANY, 218 Water street, New York, has issued useful instructions for the process of refilling commutators, as follows: "After assembling the commutator, heat it to about 200° F., or just enough to make the micanite pliable, then tighten the bars or ring as much as possible. The pliability of the micanite will allow the distribution of unequal strains and will counteract to a great extent irregularities in the dimensions of other parts of the commutator. Then continue the heating, but this time let it reach 400° F., or until the shellac, which will have oozed out here and there, has become dry. In fact the shellac may be partially carbonized with no bad results. Then retighten the commutator, either hot or cold, but preferably in both states. Do not tighten during the progress of this second heating, but wait until the shellac is baked dry. When no proper arrangements are provided for heating, the commutator can be put for a few minutes inside a boiler furnace door, or on a gasoline stove, or on a plate placed over a blacksmith's forge.

THE MOORE ELECTRICAL COMPANY has been incorporated under the laws of New York State, the directors being Leopold Wallach, the prominent counsel for several Trunk lines; Joseph Livingstone, the banker; Edward J. Wessels, general manager of the Genett Air Brake Company; and Mr. D. McFarlane Moore, the inventor. Neither Mr. Wessels nor Mr. Moore needs an introduction to our readers, as their work is well known. Mr. Moore's claims concerning current control and phosphorescent light have been made public in all the scientific and daily papers in this country and abroad, since the time when he read his paper before the American Institute of Electrical Engineers on "A New Method of Current Control." For the past five years Mr. Moore was an engineer for the Edison, Thompson, Thompson-Houston and General Electric Companies. On October 1 he tendered his resignation and is now devoting his entire energies to developing the business of the Moore Electrical Company under agreement with them. The new company has secured all the patents owned jointly by Messrs. Wessels and Moore, and an excellent laboratory has been placed at Mr. Moore's disposal.

THE FERRACUTE MACHINE COMPANY, manufacturers of presses and dies, Bridgetown, N. J., is now quite busy in its shops, having work in for five or six weeks ahead and running full time. It is building a number of presses which are especially adapted for electrical work. It has recently sent quite an outfit to the Jeffrey Manufacturing Company, of Columbus, Ohio, consisting of a large double column press, with round bed and several pairs dies for cutting armature discs. Also a special punching press with universal indexing attachment for notching armature discs. This machine will punch any number of notches in the disc from 4" to 36" diameter. It has sold several of them to other electrical firms and they have proved very popular. It is now building a very large press for the General Electric Company, of Schnectady, the weight to be about 20,000 pounds. Three of these presses are already in use in Schnectady, and are very satisfactory. It is also building a number of cutting and punching presses for various other work, and some special machinery for the Standard Oil Company. It is building a large line of presses, some 300 different kinds, and these are all from new designs, and with various improvements in their clutches, adjustments, etc. It has just shipped a very handsome press with double feed attachment, gang dies, etc., to the Frankford Arsenal, Bridesburg, Philadelphia, for making cartridge shells.

TAYLOR, DEE & MACK, 320 Dearborn street, Chicago, on October 1 made an assignment for the benefit of their creditors. Continued depression in business circles and the expressed wish of one of the partners to withdraw from the firm made an assignment necessary as the only way to adjust matters between creditors and members of the firm, without running the risk of further complications. A mee ing of creditors was therefore called for Wednesday, Oct. 3d, when a statement was made of the affairs of the company, the members of which expressed themselves as wishing to settle on a basis of one hundred cents on the dollar. It was shown that the estate could not pay that amount if closed out at once, but a proposition was made either to continue the business in the interest of the creditors until all claims were paid in full or to close out the estate at once, in which event Messrs. Taylor & Dee expressed a willingness to assume and pay up at as early a date as possible all claims not paid in full out of the proceeds of the estate. A committee of creditors was appointed to examine into the affairs of the company and report at a meeting of creditors to be held on the 6th. The committee reported that they found the statement made by Messrs. Taylor & Dee to be practically correct, and recommended that the business be continued under the assignee, for the present at least. The troubles of the firm may be laid to a wrong start, capital having been promised which was never paid in. Lack of sufficient capital led to troubles of various kinds, which finally culminated in the assignment. Messrs. Taylor & Dee express confidence in their abilty to finally pay all claims in full.

Business Notices

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 9, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

527,066. DEVICE FOR PROTECTING SEPARATELY EXCITED GENERATORS; B. G. Lamme, Pittsburg, Pa. Application filed February 28, 1894. This comprises a nominally closed break common to both armature and field magnet circuit thereof, and means for opening the break.

527,070. ELECTRICAL CONVERTER; J. W. Packard, Warren, Ohio. Application filed January 3, 1894. A converter having a primary coil, a secondary coil, and a cylinder or double ring enclosing both coils and composed of alternately arranged plates having their internal portions of unequal width.

527,071. ELECTRICAL FUSE BOX; J. W. Packard, Warren, Ohio. Application filed January 3, 1894. This comprises a core having a block at each end, one of the blocks having projecting portions in engagement with a contact ring on the box, and a spring bearing against the core and forming contact between it and the block on the box.

527,075. RUNNING COMPOUND WOUND DYNAMO ELECTRIC MACHINES IN MULTIPLE; W. B. Potter, Schenectady, N. Y. Application filed June 2, 1894. This consists in energizing the series coil of the idle machine with current from the other machines, to acquire a preliminary magnetization.

527,092. CIRCUIT CONTROLLER FOR REGULATORS; B. B. Ward, New York, N. Y. Application filed October 13, 1893. The combination with a fixed contact of a movable contact, an expanding and contracting member connected to the movable contact, and a magnet for retaining the contacts in engagement during a predetermined interval.

527,098. RAILWAY ANNUNCIATOR; C. R. Alsop, Middletown, Conn. Application filed November 2, 1893. This comprises electro-magnets, an indicating hand, an alarm circuit, and a separate hand-operated mechanical releasing device for releasing the indicating hand from either magnet.

527,099. ELECTRIC TRACK SIGNAL; C. R. Alsop, Middletown, Conn. Application filed November 27, 1893. This comprises contact springs, a signal circuit and a horizontal spring-actuated contact lever mounted to play on a vertical pivot adjacent to one side of the track rail and normally out of contact therewith, to leave a space of less width than a car wheel flange, which is adapted to move the contact lever laterally between the contact springs.

527,114. TELEPHONE TRANSMITTER; T. McConbray, New York, N. Y. Application filed Aug. 16, 1894. A telephonic transmitter provided with comminuted or powdered conducting material held in place by two disks having spirally corrugated surfaces.

527,126. ELECTRIC LOCOMOTIVE; N. J. Raffard, Paris, France. Application filed July 23, 1891. An electric motor surrounding the axle and having multi-polar field magnets presented endwise to the armature, and having an armature of the full diameter of the motor.

527,127. COMMUTATOR BRUSH HOLDER; G. Rauch, Milwaukee, Wis. Application filed April 28, 1894. An insulating base, longitudinally adjustable sleeves, shells adjustable in the sleeves transversely of the base, a binding post and brush guide on each shell, and a crab that has one arm under spring tension within the shell and its other arm loosely engaging with the adjacent brush guide.

527,150. ELECTRIC OR AMALGAMATING APPARATUS; J. C. Ludwig, San Francisco, Cal. Application filed March 5, 1894. This comprises a sluice-box, a metallic plate having pockets on its surface, a swinging frame, and means to connect the frame with one pole of an electric generator, an apron attached to one end to the swinging frame and covering the surface of the metallic plate and means for connecting to the plate a conductor from the other pole of the generator.

527,177. ELECTRIC SWITCH; R. S. Kelsch, Chicago, Ill. Application filed May 28, 1894. This comprises a support, loop line conductors and main line conductors, and a switch bar provided with ferrules separated by an insulating space.

527,195. ALTERNATING CURRENT MOTOR; C. Coerper, Cologne, Germany. Application filed May 15, 1894. The combination of an armature provided with unwound radial arms, and field magnets composed of two semi-circular sections having inwardly projecting pole pieces at the ends thereof, every two adjacent poles of which act simultaneously on adjacent arms of the armature.

527,211. ELECTRIC CAR LAMP; M. Mayer, New York, N. Y. Application filed June 18, 1894. This comprises an inverted base and a hanging glass connected at its upper edge to the base, carbons and converging carbon holders, means for feeding the carbons with uniformity in one pair of holders, and an electro-magnet and connections for acting on the other carbon in drawing the arc.

527,225. ADJUSTER FOR FIELD MAGNETS OF DYNAMO ELECTRIC MACHINES OR MOTORS. M. Waddell, Bridgeport, Conn. Application filed September 6, 1893. This comprises a perforated frame, fastening devices extending through the perforations to support the field magnets, and a support mounted on the frame carrying the adjusting devices upon which the field magnets rest.

527,228. ELECTRIC ARC LAMP; J. E. Woolverton, New York, N. Y. Application filed Feb. 9, 1894. Rigid tubular carbon holders converging, in combination with sliding socket within the same for the reception of carbons, lazy-tongs connections for feeding the carbons, a second pair of carbon holders, sockets and lazy-tongs mechanism and means for moving one pair of carbon holders in relation to the other pair for forming the electric arc.

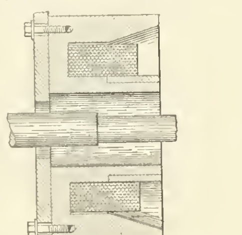
527,229. ELECTRIC ARC LAMP; J. E. Woolverton, New York, N.Y. Application filed April, 13, 1894. This comprises two fixed covering tubular carbon holders slotted longitudinally throughout their length, carbon receiving sockets movable longitudinally in the holders, an arc frame and guide bar rigidly supported and connected with the carbon holders, a tube sliding on the guide bar and having a T head and hinged links extending from the T head to the sockets.

527,244. ELECTRIC LOCOMOTION ON RAILWAYS; J. J. Heilman, Paris, France. Application filed April 20, 1894. The combination with a main dynamo driven by an engine having a fixed cut-off of an exciting dynamo driven by a separate engine and a rheostat for varying the current supplied by the exciter to the field magnets.

527,254 INSULATOR; W. D. Trimble, Baltimnore, Md. Application filed Feb. 2, 1894. This comprises an upper piece having a socket closed on all vertical sides and open on the bottom and provided with notches in its side flanges; and a clamping piece provided with notches and fitting up within the socket so that the latter projects down around it on all sides.

527,257. ELECTRIC SIGNAL; H. H Wister, Colorado City, Col. Application filed April 10, 1893. This comprises an insulated rim elastically attached to the wheel of a vehicle and adapted to engage an auxiliary rail, the wheel connected with one pole of a battery and the rim with the other pole.

527,258. SIGNAL RECORDING DEVICE; W. H. Adkins, Rome, Ga. Application filed December 22, 1893. The combination of a rotary recording disk, a



No. 527,225.—ADJUSTER FOR FIELD MAGNETS.

sliding carriage carrying a magnet and its armature, a pencil holder carried by the armature, a motor for rotating the disk and actuating the carriage, and an electric starting device for the motor connected in series with the magnet actuating the pencil holder.

527,265. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; W. A. Butler, New York, N. Y. Application filed April 20, 1894. This comprises a conduit main conductor therein, a series of brackets, each having a coupling box through which the main conductor passes, and a contact box consisting of a closed inner shell, a rocking closed outer shell, a conductor or contact projecting from the outer shell and controlling the contact within the inner shell, and a contact device carried by the car adapted to rock the outer shell to complete the circuit.

527,267. SYSTEM OF ELECTRICAL BLOCK SIGNALS FOR RAILWAYS; W. M. Cuthbert, Brooklyn, N Y. Application filed February 16, 1893. This comprises a signal post, means operated by a passing train for setting a signal, a stop for holding the signal when so set, a foreign battery, a primary open circuit and cricuit closer, a secondary open circuit and battery, a relay magnet and electro-magnets for releasing a set signal.

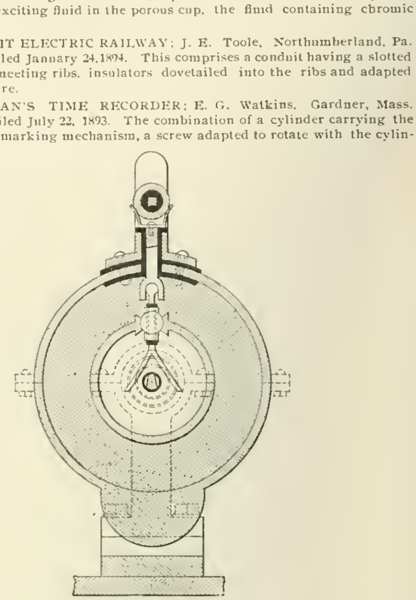
527,285. INCANDESCENT LAMP SOCKET; L. R. Peck, St. Johns, Mich. Application filed April 10, 1894. A switch block having a wall or diaphragm, upon opposite sides of which the terminals are adapted to be secured.

527,294. TRACK SWITCH FOR ELECTRIC RAILWAYS; A. F. Schinner, Milwaukee, Wis. Application filed June 16, 1894. A switch operating mechanism operated by the core of the magnets, and a single insulated strip of wire completing the circuit of the magnets, whereby when contact is made therewith by the trolley the switch point will be thrown in one direction, and when contact is made by the next trolley will be returned.

527,298. ELECTRIC BATTERY; M. E. Smith and M. F. Greer, Rochester, N. Y. Application filed March 29, 1894. This coprimses a jar, a negative electrode extending into the fluid contained in the jar, a porous cup held in the jar and extending into the fluid, a positive electrode held in the porous cup, and an exciting fluid in the porous cup, the fluid containing chromic acid.

527,301. CONDUIT ELECTRIC RAILWAY; J. E. Toole, Northumberland, Pa. Application filed January 24,1894. This comprises a conduit having a slotted bottom and meeting ribs, insulators dovetailed into the ribs and adapted to the line wire.

57,304. WORKMAN'S TIME RECORDER; E. G. Watkins, Gardner, Mass. Application filed July 22, 1893. The combination of a cylinder carrying the time sheet, a marking mechanism, a screw adapted to rotate with the cylin-



No. 527,265.—CONDUIT SYSTEM FOR ELECTRIC RAILWAYS.

der, and a stationary screw threaded bearing for supporting the screw, whereby the cylinder is displaced axially during its rotation.

527,317. INSULATOR; E. J. Bullock, Wallingford, Conn. Application filed November 27, 1893. An insulator having a body provided with an annular recess, a removable head applied to the body, and a metal wearing surface located in the recess.

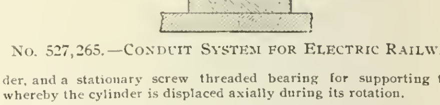
527,318. INSULATOR PIN; E. J. Bullock, Wallingford, Conn. Application filed February 9, 1894. An insulator having a longitudinal bore, a metal reinforce therein, but shorter than the length thereof, and plug fitted tightly in the open end of the bore over the outer end of the reinforce and sealing the same within the pin.

527,355. TROLLEY WIRE SUPPORT OR HANGER; S. C. Woodhead, Philadelphia, Pa. Application filed April 24, 1894. This comprises a spindle having a hook at one end and at its other a riveted head, a wire support adapted to revolve around the spindle, and wire radial arms attached to the wire support.

527,375. THERMOSTAT; L. G. Rowland, Camden, N. J. Application filed June 5, 1893. This comprises contact points, a spring pressed rod, a contact plate carried thereby, a removable nut attached to the rod, the nut having a slotted end, and a fusion plate attached to the nut.

527,377. APPARATUS FOR MOUNTING AND OPERATING THERMO-PILES; M. L. Severy, Boston, Mass. Application filed February 16, 1894. The combination of a frame, trunnions on each end of the same, vertical supports, thermo-piles, glass jacket, threaded rod pivoted to the side of the frame, a nut on the rod, and a cylinder pivoted to the support.

527,378. APPARATUS FOR UTILIZING STEAM FOR HEATING THERMO-PILES; M. L. Severy, Boston, Mass. Application filed February 16, 1894.



No. 527, 379.—APPARATUS FOR GENERATING ELECTRICITY BY SOLAR HEAT.

The combination with a steam boiler and a thermo-pile, one face of which is heated by the exhaust steam and the other face cooled by the feed water supply.

527, 379. APPARATUS FOR GENERATING ELECTRICITY BY SOLAR HEAT; M. L. Severy, Boston, Mass. Application filed February 16, 1894. A thermo-electric pile operated by solar rays and means for constantly presenting the parts thereof to be heated towards the sun from sunrise to sunset at all seasons.

527,393. BUSY TEST FOR MULTIPLE SWITCH-BOARDS; R. H. Polk, Savannah, Ga. Application filed April 20, 1894. This comprises a high tension current source, a connecting loop, and a condenser of such capacity that the talking current will not pass through it, interposed in the wire connecting the source of curreut and loop, and a test plug circuit.

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CONTENTS.

ELEKTROTECHNISCHE ZEITSCHRIFT.

The prediction we made in our issue of June 9, p. 790, that Mr. Gisbert Kapp, formerly of London, would assume the editorial management of this leading German electrical journal, has turned out to be correct. In the issue of the journal just received, it is announced that he and Mr. Jul. H. West, will hereafter be the editors. We congratulate our esteemed contemporary on the acquisition of this noted engineer and writer as its editor, and are sure that the value of the journal will thereby be greatly increased. No marked change seems to have been made under the new management, with the exception of the introduction of a department corresponding to the editorial comments in American and English papers, a department, which, strange to say, does not exist in any other French or German journal. This new department, representing chiefly the opinions of Mr. Kapp, will form an additional interesting feature of that journal.

L'ENERGIE ELECTRIQUE.

A new journal with this title has just been started in Paris. Electricity is already represented in that country by a sufficient number of journals and the introduction of a new one would not be advisable were it not for the fact that the editors in this one have wisely limited themselves to a special branch. It is their intention to make this "an organ for central station operators, consumers and municipalities," although they intend also to undertake the difficult task of keeping the public posted on all that pertains to the electrical industry, employing for this purpose semi-popular language. Although the subject of central stations in that country is already covered very well by its older contemporary, *L'Industrie Electrique*, there may be a sufficiently large field for the success of a new journal; at all events it has our best wishes for its success. The editors have, strange to say, forgotten to state whether it is to be a weekly or a monthly, but judging from the price, which is not low, it will probably be a weekly.

PHASE REGULATION.

One of the difficulties encountered in alternate current working is the shifting of the phase between the voltage and the current when a circuits contain self-induction, thus producing a wasteful "wattless" current. This difficulty is especially noticeable in alternating current power transmission, and in a certain large installation it interfered so much that the plant could not be run economically. The insertion of an over-excited synchronous motor in the circuit was suggested and, as is shown in the Digest this week, this remedy was applied to the unsuccessful plant just mentioned, after which it ran very satisfactorily and economically, thus affording a practical proof of the theory. From this it would appear to be quite safe to adopt this remedy. The case referred to was a three-phased transmission plant, but in a single-phased synchronous system the motor itself may be made to overcome the difficulty by simply over-exciting it, thus forming an apparently paradoxical system in which the motor has a higher counter E. M. F. than the voltage of the generator. Already modifications are suggesting themselves, one of which was described in the Digest last week, in which the continuous current exciter was made to take the part of a special machine for overcoming the difficulty due to phase shifting.

THE STREET RAILWAY CONVENTION.

The great success of the recent Convention of the American Street Railway Association at Atlanta completes the record which gives to the year 1894 the distinction of being a period of phenomenal professional activity, if the interest taken in the meetings of the

various electrical associations can be accepted as a criterion. The social side of the convention was a decided success, and fully justified the stress laid upon this feature in the preliminary announcement of the secretary. Not less so was the part of the commercial programme that received its realization in the exhibition in the Machinery Hall, and the appreciation so fully expressed in regard to the value of this department will doubtless hereafter render it the object of more attention than it has sometimes received in the past. Last, but by no means least, is the full programme of professional papers. While these did not receive at the meeting the attention merited, yet this could scarcely be otherwise in view of the limited duration of the sessions and the great demands from other directions on the time of the delegates. This, however, detracts very little from the value of this part of the programme, as the papers will later receive the mature consideration which it would be impossible under the most favorable conditions to give at a convention. On the other hand, the lack of discussion is to be regretted, but it is possible to make amends for this by encouraging written communications on the various papers, to be subsequently published in the annual report of the Association. While these would thus be lacking some of the merits of discussions at the meetings, yet this would probably be more than compensated for by the more careful thought that would be given to the subject considered, and have the incidental advantage of allowing the editor to use his blue lead pencil —which prerogative might sometimes be more freely exercised under the present conditions than has been done. Of the many papers read those of Messrs. Bettis and Harrington are of particular interest. The proper classification of steel railway accounts is a matter of importance aside from its value in the management of companies. The engineer in studying the best disposition of the various factors that enter into the design of a plant, with a view to the highest economy in subsequent operations, is frequently much handicapped for data, which the system proposed would go far toward supplying. It will also furnish a means of comparison for street railway managers with other plants, and thus enable him to discover under which head there is a probability for a reduction in expense. The investigation of Mr. Harrington is an interesting one, and brings out strongly the fact that the controlling factor in the use of fuses is not the capacity of the fuse as much as the carrying capacity, so to speak, of the arc which may follow when the fuse is "blown." The use of Mr. W. S. Barstow's "booster" system for use with electric railways, as advocated by Messrs. Vail and Wynkoop, brings up an interesting question, and the great claim of efficiency made will doubtless cause the matter to be carefully considered by engineers. It seems hardly probable, however, that under the conditions of actual street railway operation the theoretical conditions assumed by the authors of the paper in their calculations for efficiency can be realized, as the continuous operation of the railway motor at a high efficiency is implied, which is far from being the case in practice.

NATIONAL LABORATORIES.

Although America is justly given the credit of being usually ahead of other nations in the introduction of anything new, yet in some respects, we regret to say, the American government is far behind the governments of the other large nations. One notable instance is in the total absence of a national electrical laboratory for the purpose of making, preserving and comparing the national electrical standards and for enabling anyone for a reasonable fee to have his secondary standards, measuring instruments or meters, duly compared and calibrated and marked with an official stamp, carrying with it the guarantee of the government that the instrument either reads correctly or that its error is so-and-so much. The only ways in which a person who has no facilities himself, can now have an instrument or standard compared and calibrated, is either to send it abroad, which one would naturally dislike to do, or have it done by some expert or at some university. The latter is the course generally pursued here, but it is evident that no matter how good the authority, it does not carry nearly the weight of a government guarantee, nor can any expert or university afford to make a business of such work without going to an expense which would involve such high fees that comparatively few could avail themselves of such an opportunity. Besides, there would not be the necessary uniformity in the calibrations, as there would doubtless be a difference in the standards of different parties, at least when it concerns very accurate work. Whether the government standards are exactly right or not, would not be so serious, as long as all standards in use in this country were based on them. The government would, furthermore, have an opportunity to compare its standards with those of other countries, a privilege which no expert or private institution could obtain. Among the national laboratories in Europe, Germany leads with its excellent Reichsanstalt, until recently under the leadership of von Helmholtz. England is now installing its Board of Trade Laboratory, a government institution, although having a much more limited scope than the German Reichsanstalt. France has its Laboratoire Centrale, which is now under the auspices of the International Society of Electricians, whose headquarters are in Paris and therefore is not strictly speaking a government institution, but the government has recognized it by aiding it and it has also received various endowments; although the internationl standards of France would not be in its care, as there is another department in the French government where such standards are preserved, it will no doubt be able to obtain duly compared duplicates, and its verification and calibration of other instruments would doubtless not be questioned. Austria is about to establish a government department in which meters and other electrical measuring instruments can be calibrated and officially stamped. The United States, the country in which the electrical industry has developed more rapidly and to a far greater extent than in any other, stands alone in having nothing whatever to compare with the national laboratories of the other leading countries. Our government has its standards of weights and lengths, and it is only a question of time when it must provide itself with standards of electrical measurements. As this time must come why wait until after the need has been felt too much? The international standards have now been fixed, and there is no longer any excuse for not obtaining a number of them, and at the same time providing facilities for having commercial standards compared with them.

Even Lightning is Slow There.

An English contemporary, which is generally careful in its statements, publishes a photograph of a bolt of lightning which it says was taken in the following way: "Mr.—— had a —— camera in his hand during the thunderstorm of July 15th, in broad daylight, and a lightning flash occurred; he quickly pointed the camera at it and snapped the shutter." Our American lightning has more of the American go-ahead qualities about it, and we fear it would have been a waste of a film to have tried that in this country. But perhaps that photographer was an American hustler, or perhaps his camera happened to be pointed in the right direction and it required merely the pressing of the button to catch a slightly belated secondary flash.

Germ-proof Telephone Mouthpiece.

Although the invention is not new, yet it may be of interest to call attention again to the fact that in Germany a mouthpiece is being introduced to avoid the spread of disease carried by the condensed moisture of the breath; the mouthpiece contains a pad made of a large number of disks of paper with a hole in the middle, of which the upper sheet is torn off after each conversation.

An Argument for Rapid Transit.

In the year 1891, the average number of rides on street railways in New York, including the elevated lines, per inhabitant per year, was 267, which is almost double that in Berlin, 140, more than double that in London, 116, and more than four times that in Paris, 84.

Electricity vs. Matches.

A testimony for electric lighting, published in London "Lightning," reads "Invaluable for preventing deterioration of stock. A matchless safety against fire."

ELECTRIC SYSTEM OF THE PHILADELPHIA TRACTION COMPANY

BY HERMANN S. HERING.

II.

THE MAMMOTH WESTINGHOUSE GENERATORS.

The 1,500-hp direct-coupled generators which are being installed as mentioned above, are a comparatively new feature in railway work, and a more detailed account of them will doubtless be interesting.

Fig. 13 is an outline drawing of the 1,500-hp machine, and gives the side view, end view and plan. Fig. 12 is a photograph of one of the generators at the Mt. Vernon power station. An idea of the size of these machines can be obtained from Fig. 14, which shows one of the workmen of the Westinghouse Company standing inside of the field of one of these machines in the Westinghouse shops.

From these views, the general arrangement can readily be seen. The machines are similar in design to those at the World's Fair. They have 10 poles and a circular yoke, 12½ feet outside diameter. A valuable feature is that the field is divided vertically into two parts which can be slid apart on the base plate, giving access to the armature and field coils so that repairs can readily be made without disturbing the engine.

The field is designed according to the usual Westinghouse practice, with cast-iron yoke and wrought-iron, laminated pole pieces. These pole pieces are built of sheet iron punchings, held together with riveted end-plates, and the whole cast into the massive cast-iron yoke, thus securing effective protection against eddy currents in the cores, together with perfect magnetic contact between core and yoke. The machine is compound wound, but a new feature in the winding is that the series coils of the various pole pieces, instead of being connected in parallel, as is customary, are all connected in series, the entire current passing around each, which secures more perfect magnetic balance. These series coils have an enormous cross-section, and are made of strips of Lake Superior drawn copper, forged into spirals, taped and then compressed. One of these coils is shown in Fig. 15. The shunt coils are wound on substantial sheet-iron bobbins and are connected in series with each other as is usual.

The armature also shows some new departures. It has a slotted core built up as a ring, in sections of laminated sheets between two brass end-plates, and securely held together by mica-insulated bolts. The laminated ring is pressed upon the cast-iron hub and securely keyed on. Fig. 16 shows a core of an armature of one of these 1,500-hp generators, finished and ready for the coils to be placed into the slots. Before being wound, this armature is pressed on the engine shaft by means of a hydraulic press. The armature coils are individual and are wound on lathes into a special shape, all together to constitute a continuous parallel drum winding. They are well insulated with mica and have to stand an insulation test of 5,000 volts alternating current, after being placed in the slots. The leading advantage in this method of construction, is that any given coil can readily be removed from the core without disturbing more than a few adjacent coils. No binding wires are used, either on the core or on the projecting ends of the coils. The armatures of the machines of the Philadelphia Traction Company were wound and connected after being mounted in place on the engine shaft, the entire work for a 1,500-hp generator consuming a

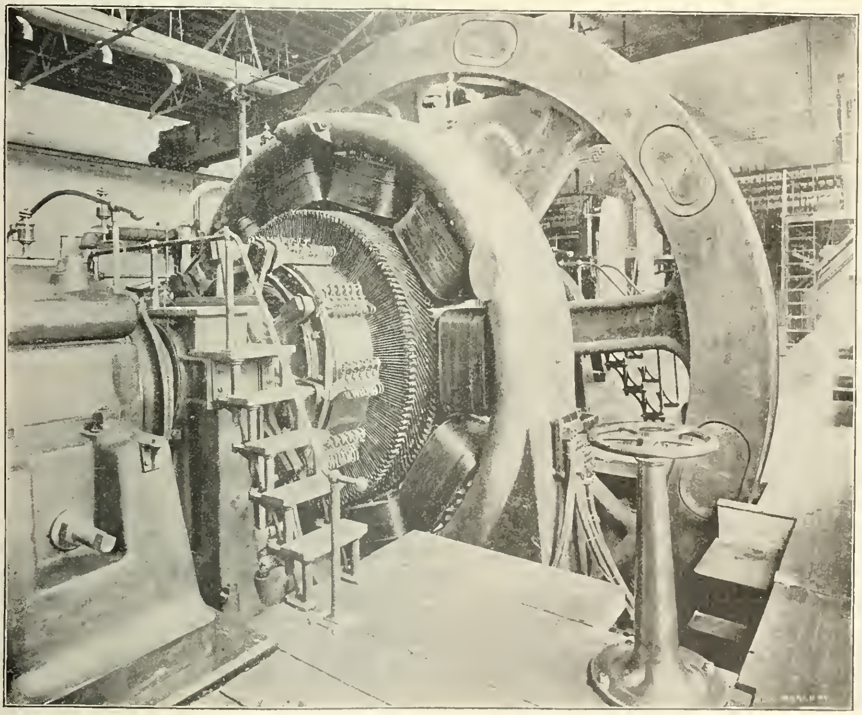


FIG. 12.—1,500-HP GENERATOR, STATION B.

remarkably short space of time; this method has the advantage of doing away with the risk involved in the transportation of a completely wound armature of these dimensions. The diameter of the 1,500-hp armature is 7½ feet, and its width is 22½ inches; the 750-hp armature, as used at the Sutherland avenue station, is 6 feet in diameter and 25 inches wide.

The commutators are entirely built up of drop-forged copper segments, insulated with pure mica. The segments are supported on a ring, making a part of the cast iron armature hub, and are clamped together by taper rings in the usual way, the only, but important, difference being that the outside is made in sections, so as to allow any special strip, or part of the commutator, to be removed, in case of repair, without taking the whole apart. These commutators are subjected to a test of 5,000 volts alternating current before leaving the shops. The diameter of the one for the 1,500-hp machine is 5 feet, and for the 750-hp machine is 4 feet.

The current is collected by carbon brushes, five of which are located in each of the ten brush holder arms. The brushes are individually clamped in a light brass housing, and this is connected to the support by a flexible copper shunt, thereby doing away with all sliding or vibrating contacts inside of the brush holder box. The ten arms are thoroughly insulated and fastened to the iron rocker spider, which can be revolved by means of hand wheels and worm gearing. The rocker spider is held by a stand which is bolted to the engine foundation, and allows the spider to rotate upon a bearing. The arrangement can be plainly seen in the diagram, Fig. 12, and in the photograph, Fig. 13. Formerly the brush holders were supported by arms bolted to the yokes, the bosses of which can be seen in the photograph, Fig. 13. This rendered the brushes difficult of access, while the new plan, allowing of a well insulated stairway to be built over the stand, enables the attendant to readily get at the brushes and also to go from one side of the machine to the other without going around the engines or through the basement. The shifting wheel is of the usual engine pattern, being a 19-inch hand wheel on a 3-foot pedestal placed on the floor, one on each side of the machine, as shown in Figs. 12 and 13.

The weight of the 1,500-hp generator, complete, excluding the shaft, is 130,000 pounds.

The 1,500-hp generator, running at a speed of 80 revolutions per minute, gives 2,250 amperes at 500 volts, while the 750-hp generator gives 1,125 amperes, running at the same speed and voltage. Machines of both sizes are running daily up to the maximum capacity without signs of heating, or any undue sparking at the brushes, and the engineers of the Philadelphia Traction Company say that they have given entire satisfaction so far.

The Westinghouse Electric & Manufacturing Company during the past year received contracts from the Philadelphia Traction Company for 12,750-hp of these generators, divided into six machines of 1,500-hp each, and five of 750-hp.

Mr. R. S. Feicht, the able representative of the Westinghouse Company, in Philadelphia, is superintending the erection of these machines, and the author is indebted to him for the data concerning them.

The Westinghouse Company is also furnishing similar machines, ranging from 300 to 1,500-hp, to power stations in Atlanta, Ga., Indianapolis, Ind., Fairhaven, Conn., Louisville, Ky., Jersey City, N. J., and other places, and this company is to be congratulated upon their success with these machines.

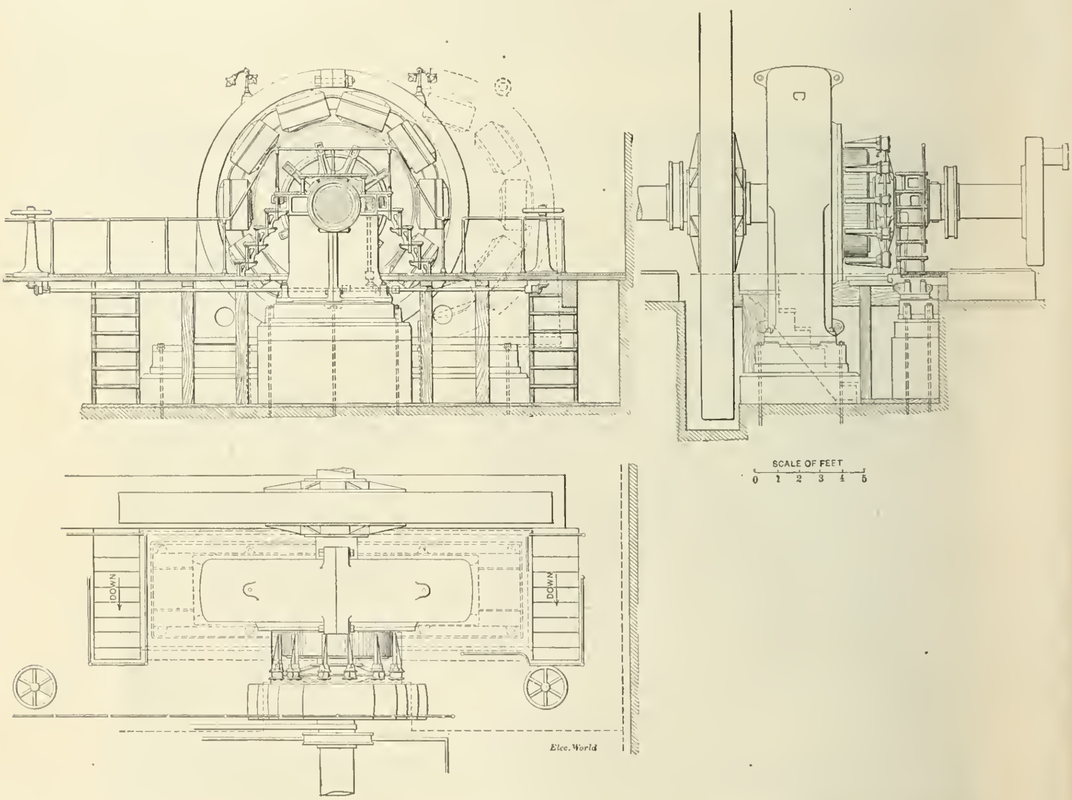


Fig. 13.—Outline of 1,500-hp Railway Generator.

THE TESTING ROOMS.

Each of the four power stations has a testing room equipped with instruments for measuring the insulation resistance of the cables, and with telephones for communicating with the workmen in the subways. The equipment is practically the same in all of them, and consists of a special arrangement of apparatus designed for the purpose, namely, the commercial testing of cables, and planned by Mr. Wm. D. Gharky, the superintendent of underground work. This apparatus is placed on a large pier with stone top, and, in addition there are switches, drops and call-bells for the telephone

circuits. Fig. 17 shows a general view of the testing-room at Station B, 13th and Mt. Vernon streets, with the instruments on the pier in the foreground, and the telephone apparatus to the right in the rear. Fig. 18 shows a plan of the room with all of the apparatus and a diagram of the connections.

Thomson galvanometers were originally used in these rooms, and were shielded by means of two concentric sheet iron cylinders filled

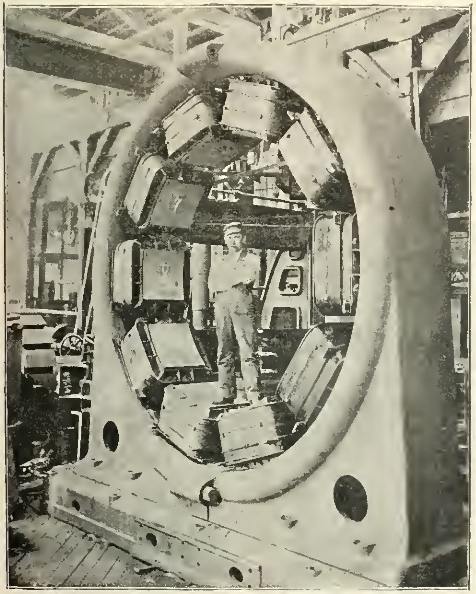


FIG. 14.—FIELD MAGNETS OF 1500-HP GENERATOR.

between with iron turnings; but they were still affected by the feeder currents in the basement and so were discarded, and the new form of D'Arsonval galvanometer made by Queen & Company, substituted with entire satisfaction. Both of these are shown on the pier in Fig. 17. The scale is a transparent one, supported so that it can slide from one side of the pier to the other, and thus be used for either galvanometer or for shifting the zero. A lamp is placed at

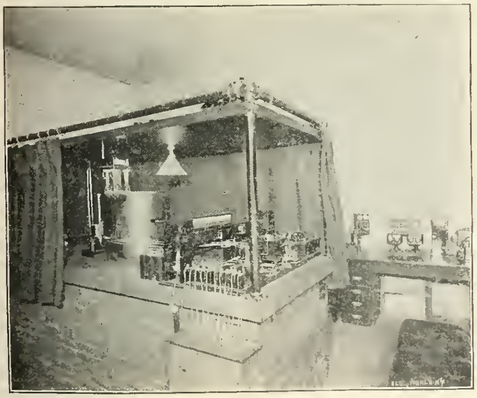


FIG. 17.—TESTING ROOM, STATION B.

each end of the scale, one for each galvanometer, the several lamps used about the table being conveniently controlled by switches. The light spot is a sharp clear line which is easily read. The galvanometer leads are well insulated and run to the shunt box and key and thence to a 100,000 ohm resistance box, from which connections are made with the chloride of silver battery, Wheatstone Bridge, keys, etc., in such a manner that the connections for the various tests—Insulation, Conductor Resistances or Capacity, and can be made simply by shifting the plugs, following in general the scheme suggested by Mr. Carl Hering.* The method of making the test is substantially as described in the same article. In changing from one test to another, it never becomes necessary to change a wire in a binding post; the "wiring," in fact, is permanently made up of brass rod. At the near corner of the pier is a switchboard with terminals connected to well insulated leads, running to the vaults, by means of which the various cables can be connected with the testing apparatus, and also with the telephones to enable the operator to converse with workmen in the vaults and at the manholes. Access to them in the manholes is by means of small junction boxes. Telephone cables run through all the subways; but idle cables are

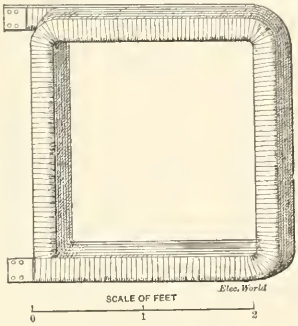


FIG. 15.—SERIES COIL OF 1500-HP GENERATOR.

sometimes used instead. At present there are about 30 miles of telephone cable. The group of lamps over he pier are for the purpose of detecting dead-grounds, and also to determine whether a cable is entirely dead, before the operator starts to test it.

The insulation resistance of the cables is determined just after they are laid and also before they are put into use, but not at other times unless some repairs have been made, or there is some special

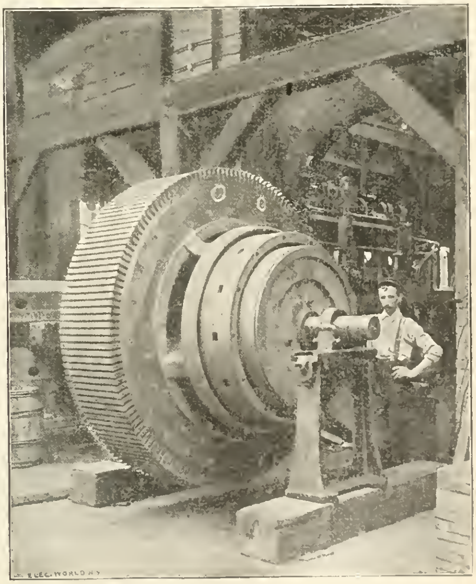


FIG. 16.—ARMATURE CORE OF 1500-HP GENERATOR.

reason for doing so. Very few faults have occurred since the underground system was placed in service, and they were due generally to carelessness on the part of workmen and were easily located; but when faults do occur, the simplest plan is to locate them by disconnecting the cable at the junction boxes in the manholes, one section after another (continuous insulation tests being kept up)

*The Electrical World, March 7, 1891, p. 188.

until the fault is found, and then replacing the defective section between the manholes, which is a distance of from 200 to 400 feet. Attempting to locate such faults electrically in 200,000 to 1,000,000 circular mile conductor, even in cases of a dead ground, would be uncertain on account of junction resistances, earth currents, etc., and involve more trouble and expense than the "cut and try" method. It is of course hardly necessary to remark that the work done in a testing station of this kind is carried out on a business basis, with the same practical routine and discipline as the operation of a Power Station. Reports of the various values of a cable which are practically correct, and this in the shortest time possible, are the result sought, rather than the exactness of the Laboratory. The arrangement of the apparatus is such as to secure the greatest convenience to the operator, and thus facilitate the work.

The instrument for all the testing rooms at these stations was furnished by Queen & Company, Inc., of Philadelphia.

POWER DISTRIBUTION.

The general system, adopted by this company, of distributing the power, is to feed insulated sections of the trolley by means of independent feeders from the power stations, this method being necessary on account of the possibility of accident to the underground feeders, and because any feeder must be capable of being cut out without interfering with the operation of the road. Feeders run from the switch board of the power station to the vault in the basement, where there is a junction box. From this junction box the lead armoured cables run into the conduits and to the section of the line which they supply, which section is usually a length of from 1,000 to 4,000 feet. This portion of the trolley is connected to the feeder cable from 3 to 5 times and is insulated from the adjoining section of trolley by a section insulator. Each section, therefore, is independent, and if any trouble occurs in the cable or underground connections, the section can be disconnected from the cable and connected to the adjoining sections temporarily, which renders a stoppage from cable breakdowns a difficulty quite easily remedied and with but little delay. The return circuit is through a complete system of return feeders, which are carried in the conduits and are connected to the rails at every manhole. These return feeders run to the switchboard at the power station and convey practically all of the current, very little returning through the earth.

(To be continued).

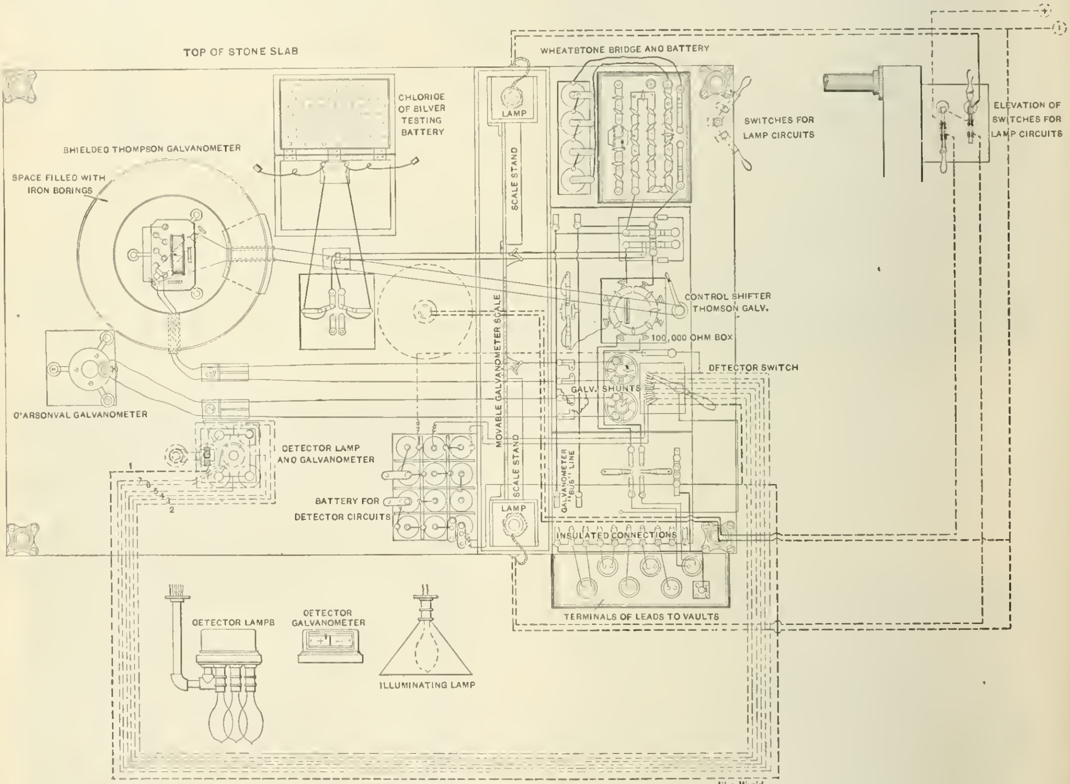


Fig. 18.—Arrangement of Instruments, Mt. Vernon Station Test Room.

Electric Traction in France.

Electric traction is still in Europe such a novelty that the "inauguration" of a complete urban system is marked by a ceremony which is frequently pleasant and at times positively overwhelming. In February, 1874, the town of Havre was the first to adopt horse tramways, and on the 25th ult. it formally became the first town in France to apply electricity entirely to the same network. The tramway company and the electrical contractors (The French Thomson-Houston Co.) celebrated the occasion by issuing 400 invitations, taking down their guests from Paris by a special train, feasting them at Havre with "sumptuous" breakfast, luncheon and dinner, carrying them about in a triumphant procession in ten trolley cars up and down the town, and finally starting them all back to Paris on the following morning at sunrise. It is to be hoped that as electric traction becomes less novel, the inaugural ceremony will become less trying. An item of considerable novelty in connection with this line is the fact that the current is supplied by the local electric light company, although not from the lighting dynamos, since the company's system is alternating. The traction plant consists of three 4-pole, 200-kilowatt, 500-volt Thomson-Houston dynamos rope driven by Farcot-Corliss condensing engines. The rolling stock consists of 40 cars, 24 of which are driven by a single 25-hp single reduction motor, the balance having each two such motors. The network of the tramway company is equal to 40 miles of single track.

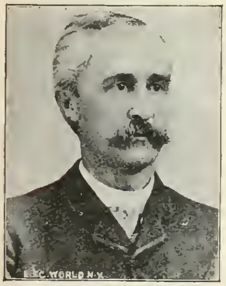
Electric Cooking.

Queen Victoria of England uses electricity for cooking at her residence at Osborne, Isle of Wight, for "the more delicate dishes only."

XIII ANNUAL CONVENTION XIII OF THE American Street Railway ASSOCIATION. ATLANTA GA. Oct. 17th 18th & 19th 1894

Notwithstanding that it was the thirteenth annual meeting, the convention of the American Street Railway Association at Atlanta last week was one of the most successful—in many respeects the most successful—ever held by the association.

Never before have the transportation arrangements been so perfect, not only for reaching the convention city but also for the home journey. The hotel accommodations, particularly at the Aragon, were excellent; the weather throughout the entire week was simply delightful; the citizens of Atlanta did everything possible to render the visit of the delegates one long to be remembered, while the papers read were numerous and important and the exhibits so complete and interesting as to be well worth making a long journey to enjoy.



JOEL HURT,
President.

W. WORTH BEAN,
First Vice-President.

The opinion was freely expressed in Atlanta that the Gate City had never entertained a more representative body of men; and that no convention ever held in that city had been more generous in its expenditures. On behalf of the visiting street railway men it may be added that the cordial southern welcome extended to the delegates will insure for Atlanta and the New South a warmer place than ever in the hearts of those who attended.

The next meeting of the association, as will be seen farther on in the report, is to be held in Montreal. Those who attended the convention of the National Electric Light Association in that charmingly hospitable city will not need to be told how promising a prospect the representatives of the street railway interests of America have, therefore, before them for an enjoyable convention in 1895.

JOHN H. CUNNINGHAM,
Second Vice-President.

RUSSELL B. HARRISON,
Third Vice-President.

At Atlanta the exhibtion and the meetings were held in Machinery Hall at Piedmont Park, where the forthcoming Interstate Cotton Exposition is to be held, and which is about two miles from the centre of the city. Books of special tickets, good on any of the Atlanta street car lines, enabled the visitors to travel free between the place of meeting and the hotels and the service to the ground was so prompt and efficient that the journey did not count.

FIRST DAY — OCT. 17th 1894

The first session took place on Wednesday morning, the attendance being quite large and the interest in the proceedings unmistakable.

President Henry C. Payne, of Milwaukee, called the meeting to order and introduced Hon. W. J. Northen, governor of the State, who extended a most cordial welcome to the Convention. He called attention to the delightful climate of Georgia and its great resources, and expressed the hope that visitors would not only return to visit the Exposition but would bring their industries and settle in the State. The South, the Governor said, had felt the financial stress far less than the North. The records also show that the people of the South owe less money than those of any other section. He suggested that the cheaper raw material and better manufacturing advantages of Georgia ought to prove a strong inducement for the investment of capital. Already the South had 1,611 miles of street railways, with an invested capital of $71,000,000. The Governor thought the street railway the greatest factor of civilization known to the modern world.

President Payne, on behalf of the association, fittingly acknowledged Gov. Northen's welcome.

Letters of regret at their inability to be present were read from past presidents Chas. B. Holmes and Henry M. Watson.

President Payne then delivered his address. The depression which had prevailed in all parts of the country, he said, had not been without its compensations, as it had limited the constitution of unproductive lines and enforced economy. During the transition from animal to electric power the association had devoted its attention largely to the application of electricity to transportation purposes, but now the practical operation of the roads should be considered. President Payne thought the management of a street railway equipped for rapid transit more vexatious than that of a steam road and requiring quite as much ability. The wonderful development of the electric railway had led to excessive valuations of franchises which has resulted in excessive taxation. The President also called attention to the various topics before the convention for discussion, and closed with a brief tribute to the memory of Wm. Richardson and W. J. Stephenson.

The report of the Executive Committee, which was then presented, in commenting on the business depression, said: "Business in general during the last year has been bad, and the street railway business in particular has suffered, several of our member-companies having gone into the hands of receivers, while consolidation still continues to be tne trend of the times. While the year has been a hard one, the business outlook is encouraging, and we look forward with confidence to a successful year's business."

The report enumerated a number of changes which had taken place in the membership, the present number being 184 companies, exclusive of additions at the Atlanta meeting. Reference was made to the special reports to be presented as covering a wide range of subjects, and the commitee touched upon the subject of the exhibition of street-railway supplies, which was fast becoming a prominent feature. A list of judicial decisions published during the year was given, and it was stated that the second volume of "American

Street Railway Decisions" would be issued during November. Two amendments were submitted, one to the Constitution and one to the By-Laws. The proposed amendment to the Constitution is to provide for the admission of individuals and companies, not street railways, as associate members, under certain conditions; such character of membership having been found conducive to the general welfare of kindred associations. The proposed amendment to the By-Laws has in view morning sessions only; providing for less exhaustive meetings; for more opportunity for social enjoyment, as well as for opportunity to examine the display at the Exposition, which has become so important a feature of the annual meetings. The adoption of the foregoing amendments would mean that there will be in the future two classes of membership—associate and active; and that the meetings will open on Tuesday and continue for four days.

The report of the treasurer showed that the receipts for the year had been $8,290.79, and the expense $8,196.72, leaving a balance of $94.07.

A communication from the Georgia Electric Light Company was read, extending an invitation to the delegates to visit its plant.

The first committee report presented was on "The Best Method of Treating Accidents and Complaints," and was read by Mr. P. M. Dyer, claim agent of the West Chicago Street Railroad Company. This paper will be found in another column.

In the discussion which followed, Mr. Dunlop, of Washington, stated that the paper embodied his views on the subject. President Payne said that his company pursued the same course, and that as they had little chance before a jury, settled a case as soon as possible. In reply to inquiries from Messrs. Little, of New Orleans, and Shaw, of Newburyport, Mr. Dyer said that the statements they obtained from their employees sometimes, but not always, were sworn to before a notary public; that the motorman who was found responsible for an accident was sometimes assessed and sometimes discharged, depending upon the frequency of the accidents and his record. In a case cited, where a motorman turned his head away and ran over a person, he stated that they would discharge such a man as soon as a statement was obtained, regardless of the cause which led him to look away. Mr. Fuller of Chicago, stated that it was the rule of the West Chicago Railway Company that one car approaching another must slow down or stop before reaching it, and a motorman was discharged for the violation of this rule. In regard to temporary relief, Mr. Dyer said that his company provided it to the extent of transportation to home or hospital and the payment of the physician called to the drug store or other place where the injured person had been temporarily carried. Mr. Shaw cited two cases where men had been injured in his power-house where the company was not responsible and claims had been brought against them. Mr. Dyer stated that in such a case the first thing would be to ascertain the law, and that even where the company was not legally responsible the question of charity would come up, in which case a release should be exacted. He said his company had been insured from 1890 to 1891, but since then had taken its own risks. Mr. Payne stated that the trouble with insurance companies is that they do not insure more than half the accidents. Mr. Connette, of Nashville, stated that his company pursued about the same method as that outlined in the paper. After the accident occurred they investigated it immediately and if they found the company liable then they took the best care of the injured party possible; if they found the company was not liable then they ceased expense altogether. They found that if they could not settle a case the best way was to keep the matter in court as long as possible, as it was then more easily compromised; they also found it wise to use their influence to get such men on the jury as would give a corporation justice. Mr. Cole, of Elmira, said that in case of accidents they generally promised the motorman that if he could obtain evidence sufficient to exonerate him from all blame he would be reinstated in his position, and that in a good many cases the motorman had been able to do this. In case he did not succeed he was suspended and given other work until the case was settled and he was then generally discharged.

The next business was the report on "A Uniform System of Street Railway Accounts" by Mr. H. I. Bettis, reprinted in abstract elsewhere. In the discussion Mr. McNamara, of Albany, said that in Albany they are required to distinguish between roadways and track, and renewals of ties, rails and paving ties, rails, spikes, joint plates, paving, sand, stone, labor ought to come under one head, and this is what is required by the Railroad Commissioners of New York. They do not object to dividing as much as desired in the books, but in the report submitted by them, they must all come under one head.

Mr. Dyer of Augusta said he did not suppose it would be possible to get a form to fit every case, and that a small road, if the proposed plan were entirely carried out, would find it expensive, because they would be compelled to have a storekeeper who would charge up the different things used each day. He thought it the custom with small roads to charge up their bills each month as they come in, as if they had been used. It is not correct, but the expenditure for the man to take charge of the store-room and keep accounts of the material used, would be in some cases almost as much as the cost of the material.

Mr. McNamara added that he has not a large road, but has a storekeeper who charges the several accounts with the material as it is used. There is no other way to determine what is used in any particular month in the year, as the writer of the paper suggests. The storekeepers are not paid such a large amount, and it is found that they do good work and that it pays.

After several announcements the convention adjourned.

SECOND DAY — OCT. 18th 1894

An executive session was held on Thursday morning, by order of the Executive Committee. The subject of "Transfers and Commutations," was first considered, the general impression being that the privileges should not be extended further than is absolutely necessary. The subject of the formation of a street railway mutual fire insurance company was also taken up, and on motion of Mr. Russell B. Harrison the incoming officers and executive committee were appointed a committee to report on the subject. On motion of Mr. Littell of New Orleans, Messrs. Littell, Perrine and Connette were appointed a committee to wait upon the officers of the Underwriters' Association of the South, with a view to securing better conditions and rates for insurance of street railway properties, the office of the Association being in Atlanta. The executive session was then adjourned.

Mr. Strathearn Hendrie then presented his report on "Can the T-Rail Be Satisfactorily Used in Paved Streets?" an abstract of which is printed elsewhere in this issue.

On motion of Mr. McLean, the following gentlemen were appointed a committee to nominate officers and select a place for the next meeting: Messrs. McLean, Connette, McNamara, Baumhoff, Breeg, Semmes and Rugg. Letters of invitation inviting the Association to hold its meeting in their respective cities were presented in behalf of Cincinnati, O., Philadelphia, Pa.; and the invitation extended at the Milwaukee meeting by Mr. Lusher, of Montreal, for the Association to hold its meeting in that city for 1895 was read by the secretary.

THIRD DAY — OCT. 19th 1894

The meeting was called to order at 10.30 A. M. the first business being the report of the committee on "City and Suburban Electric Railways" by Mr. E. C. Foster, an abstract of which will be found in another column.

Mr. Russell B. Harrison then read a report on the "The T-Rail Construction of the Terre Haute Electric Railway" which will be found abstracted elsewhere in this issue.

Mr. Harrison, in reply to inquiries from Mr. Seeley, said that he could not give any comparison between the cost of the T-rail construction as compared with girder rail construction of the same weight, as they had not laid any girder rails of the same dimensions as the T-rails. He said that his company had had no experience with granite blocks, but he was confident that the rail could be laid as successfully with such a paving as with brick or asphalt. Concrete foundations gave a perfectly smooth traffic. They spared no expense to make the joints as solid and rigid as possible. As to expansion

and contraction so much of the metal was below the surface that very little trouble was suffered from this cause. The joints are Wheeler joints and rest on the tie and the rail is stamped up with concrete, so that not only the ties but the rails rest on solid concrete. The result is that there are practically no joints in the rails.

Telegrams were read from Thomas Lowry, president of the Twin City Railway Company, Minneapolis, and from the Commercial Clubs of Minneapolis and St Paul, inviting the association to hold its next meeting in the great convention city of the Northwest —Minneapolis.

A letter from O. T. Crosby was read regretting his inability, owing to pressure of business, to present a report on "Standards for Electric Street Railways." On motion of Mr. Perrine, the Committee on Standards was continued.

M. K. Bowen, of Chicago, recommended that a committee be appointed to investigate the subject of the validity of patented articles used by street railways, and Mr. Perrine moved that a committee be appointed on this subject. The motion was carried.

The matter of the proposed amendments to the Constitution and By-Laws was then considered. An informal vote was taken as to the adoption of the amendments, and it was the unanimous judgment of the members that the amendments should be adopted. Final action on the same will be taken at the next annual meeting.

The special committee appointed to interview the representatives of the Underwriters' Association of the South reported that they had been unsuccessful in their efforts.

Captain Brophy, of Boston, representing the Mutual Insurance Association of New England, thought it would be better for each State association of railways to make application to the board of underwriters of the mutual companies which control its territory, and that something might be done in this way to secure a reduction. His company had been insuring electric light stations for two years and car-houses for one year, and had at present $7,000,000 of property of this class. For the 10 or 12 months ending in October their loss had been $2,300 on the $7,000,000, so that the electrical business is not as hazardous as some people think. Their rate for electric light stations is one per cent., which calls for a model station. They do not insist upon cement or iron floors, nor that the roof shall be 18 feet high, but they ask that the plant be clean and that there be no oil on the floors, no finish on the walls and no attics or basements. If there is a basement or second floor used for storage, it must be equipped with automatic sprinklers Their experience with car-houses had been, so far, very fair, but they could not yet tell how much the losses would be. Their expense for inspectors amounted to 6 per cent. of the premiums received and the total expense, including losses, to 12 per cent. They had no special district, although the majority of their business was in New England. Of the $7,000,000 about $500,000 was on railway property. Their rate on brick power-houses is one per cent., on frame power-houses one and one-quarter per cent.; on car-houses and contents (including cars), brick, one and one-quarter per cent.; frame one and one-half per cent. They were limited to $60,000 on one building and contents, and therefore could not insure the larger street railway companies.

Mr. Harrison agreed with the suggestion that it would be of great interest and profit to the association if a committee were appointed, and moved that a committee of five be chosen to take up the matter with the New England companies.

Mr. Seeley stated that the Standard Oil Company carried its own insurance with a profit, and thought there was no reason why the street railway business could not do likewise and establish a mutual company of its own with a central office.

The motion to appoint a committee was carried and the following gentlemen were appointed by the president: Messrs. Harrison, Terre Haute; Dyer, Augusta; Perrine, Trenton; Lusher, Montreal; Baumhoff, St. Louis.

Mr. Perrine offered a resolution to the effect that the Executive Committee take under consideration the question of the enlargement of the field and scope of the association, and submit a plan suggesting ways and means therefor, at the next meeting of the Association.

The Nominating Committee then presented the following report: President, Joel Hurt, Atlanta, Ga.; first vice-president, W. Worth Bean, St. Joseph, Mich.; second vice-president, John M. Cunningham, Boston, Mass.; third vice-president, Russell B. Harrison, Terre Haute, Ind.; secretary and treasurer, William J. Richardson, Brooklyn, N. Y.; executive committee, Henry G. Payne, Milwaukee, Wis.; W. H. Jackson, Nashville, Tenn.; D. G. Hamilton, St. Louis, Mo.; G. C. Cunningham, Montreal, Canada; J. N. Partridge, Brooklyn, N. Y. These officers were duly elected.

The committee recommended Montreal, Can., for the next meeting. A motion was made to adopt the report, except as to Montreal for the place of next meeting. This motion was annulled by a motion to adopt the report of the committee as a whole, which was passed by a vote of 37 to 19.

Mr. Penington moved that Philadelphia be substituted for Montreal as the place of meeting. A spirited discussion ensued on the question and amid the calling of the roll much interest was manifested as to the result. The vote when taken stood as follows: Montreal, 38; Philadelphia, 17.

Mr. Cunningham, of Montreal, arose to express his pleasure that that city had been decided upon as the next place of meeting of the Association, and assured the members that there would be no difficulty in bringing supplies to Montreal, and that there would be no hindrance to the exhibition, which had now become so important a feature of the annual meeting.

The report of the committee on "Mail, Express and Freight Service on Street Railway Cars," by Mr. R. McColluch, was read by title only; an abstract of this paper is given elsewhere

The report of the committee on "Transfers on Street Railways," by J. N. Beckley, was then read by title; an abstract is given on another page.

The report of the committee on "The Use of the Booster on Electric Railway Circuits," by J. H. Vail and S. H. Wyncoop, was next presented and an abstract of this paper will be found in another column.

Messrs. Dunlop, of Washington, and McNamara, of Albany, were appointed a committee to escort the newly elected president to the chair. Mr. Payne introduced Mr. Hurt, who, in a few happy remarks, expressed his appreciation of the honor conferred upon him and assured the association that he would do everything in his power to advance its interests. On motion of Mr. Perrine a vote of thanks was passed to the retiring officers; the Atlanta Consolidated Street Railway Company; the Capital City Club; the Local Press, and the citizens generally of the City of Atlanta, for the courtesies, kindness and attention, and generous hospitality, which had been extended to the association.

A paper on "Destructive Arcing of Five Hundred Volt Fuses," by W. E. Harrington, was read by title only, and will be given in abstract in next week's issue.

A paper on "Brake Shoes," by D. F. Henry and Powell Evans, was read by title only, and appears in abstract elsewhere.

Mr. Davis moved that a committee be appointed, to consist of two members of the association, and one manufacturer, to investigate the subject of the adoption of a standard style of brake shoes, conduct experiments, and to report the data collected, and its conclusions, at the next meeting, without expense to the association. The motion was carried.

The report on "Power Brakes vs. Hand Brakes," by E. J. Wessels, was read by title. An abstract of this paper will appear in our next issue.

Mr. E. A. Sperry replied to a number of criticisms by Mr. Wessels on his American Institute paper, denying the superiority of the air brake and pointing out the many advantages of the electric brake.

The special paper by Allen R. Foote, on "Taxation," a brief abstract of which is given elsewhere, was read by title.

The Convention then adjourned.

The Social Features of the Convention.

The association met with a most cordial reception at the Gate City. From the moment of their arrival until the time of departure the members were showered with attentions.

On Wednesday evening, October 17, the Capital City Club threw open its doors to the visitors. Major Livingston Mims, president of the club, made a felicitous speech of welcome and the hours sped merrily with music, dancing and feasting.

The banquet given at the Kimball House on Thursday evening will be long remembered by those who remained for the speeches. All agreed that the decorations, music and menu were unsurpassed, but when President Payne uncorked the flask of Southern oratory it sparkled with greater brilliance than all the red wine, golden champagne and verdant creme de menthe.

Until after two o'clock in the morning the speeches continued.

Mr. Stedman was the first to be called upon. He explained in lively verse the origin of toasts and the function of toast-masters. New Yorkers especially appreciated the lines:

> "Until at last old Jove himself an orator Depewted
> Who was in every detail to this special office suited."

The "City of Atlanta," was responded to by Judge H. E. W. Palmer, who until recently was the manager of the General Electric Company in that section. The "New South," by Hon. L. C. Levy and "Our Country," by Hon. Fleming DuBignon, were all masterpieces, while "The Local Press," by that brilliant young journalist, Mr. Lucian L. Knight, was fairly drowned in applause. All the addresses rang with genuine fraternal feeling and North, South, East and West were welded into one sympathetic whole by the strong current of friendliness present.

The barbecue was the feature of Friday afternoon. This took place at Ponce de Leon Park, and for local color outranked all other entertainments. It was largely attended and the viands and beer vanished with modern street railway rapidity. The recollection of the long breast-high tables and wooden plates, the glowing trench, with its sizzling freight, the skilful carver armed with a cleaver, barrels half concealed by ice, and above all and everywhere the ubiquitous darkey, will linger long in the minds of the appreciative delegates.

The press of Atlanta, notably the famous morning "Constitution" and the evening "Journal," devoted great care and attention to publishing daily reports of the proceedings—a feature which pleased every one and won for these papers many new friends.

Other cities have been as demonstrative as Atlanta; other localities have risen to entertain the Street Railway Association and its attendant army of supply and newspaper men, but the Gate City threw its portals open with a grace and hospitality so courteous and unrestrained that it will ever occupy a unique position in the affection of the visitors last week it entertained so royally.

The Journey to and from Atlanta.

"Rat, tat, too, Royal Blue;
Shenandoah, Shenandoah brought us through"

is what a large and happy contingent of the association will remember of the trip from New York to Atlanta. Under the friendly care of Mr. L. J. Ellis, of the Norfolk & Western Railroad, nearly a hundred delegates and ladies were conducted in safety and comfort to the Gate City and back to Gotham. All joined in praising meals, accommodations, service; and only one unhappy man, Mr. John Ashby Seely, had cause for complaint—the climate. Whether Mr. Seely was equipped with too heavy gear or whether Heaven intends him for a cool clime we know not, but at all events it was hot enough for him.

The trip south was enjoyable but the return journey so far exceeded it in pleasure that words almost fail to describe it. Even stout-hearted Major Evans was observed to drop a tear as Jersey City loomed upon his vision.

At Chattanooga, on the way back, the delegates were allowed time to visit Lookout Mountain, Missionary Ridge and interesting points about the city. The magnificent views to be had from Lookout Mountain and the Ridge impressed even the most critical visitor with their grandeur, while the battles that formerly troubled these sunny valleys seemed like desecration. The Soldiers' cemetery, with its thousands of tiny headstones, many of them bearing no word, but a single number, stirred the living to reverential respect for the brave boys who lost names as well as lives in the war.

On Sunday morning a "sermon in stone" was enjoyed at the Natural Bridge of Virginia. A pleasant drive among the gorgeously tinted hills led to this famous freak of nature, which is a marvel, even when overrun with hilarious members of a convention. Later in the day the Caverns of Luray were visited, and there even the most flippant were hushed by the wonders of that fairy land beneath the earth. Much surprise was evinced that no energetic delegate had as yet arranged to lay tracks through those winding corridors. They contented themselves with discovering and dodging a live wire so far beneath the sod.

At Luray the passengers on the Shenandoah route passed the subjoined resolution, to be followed this week by a more substantial testimonial to Mr. Ellis from those who journeyed under his charge.

Whereas, a large number of those attending the Atlanta Convention of the American Street Railway Association have traveled to and from that city over the Shenandoah route; and

Whereas, The unqualified pleasure and the brilliant success of the railway trip have been due to the unwearied efforts and thoughtful supervision of Mr. Leroy J. Ellis, Eastern Passenger Agent of the Norfolk & Western Railway; be it therefore

Resolved, That the hearty thanks of the passengers by the special train personally conducted by Mr. Ellis, be and are hereby extended to that gentleman for his unremitting attention to their comfort and his prompt aquiesence in any suggestion that could be met.

Resolved, Further, that Mr. Ellis be and is hereby congratulated upon the striking punctuality in the adherence to the train schedule, as evidencing the high standard of railroad efficiency in the New South; and

Resolved, That a copy of these resolutions be engrossed and presented by a committee to Mr. Ellis, together with a souvenir that may serve to remind him of the occasion as well as of the high esteem in which the street railway men and street railway supply men hold a typical steam railroad man.

Other northern and eastern delegates enjoyed the comforts of the Southern Railway in another and even longer special train. This party on the return trip stopped off at Asheville and visited the Vanderbilt estate. That the members of it appreciated the favors and courtesies extended them is shown by the following resolutions passed at Hickory, N. C., on October 21st :

Whereas, The ladies and gentlemen composing the special train from New York to the convention of the American Street Railway Association at Atlanta, October 17 to 19, travelling over the Pennsylvania Railroad and the Southern Railway, have enjoyed unusual privileges and advantages over the system of the Southern Railway, whereby they have been enabled to visit the historic grounds of Lookout Mountain and Missionary Ridge, at Chattanooga, Tenn., and view some of the grandest scenery of the world in the Blue Ridge Mountains around Asheville, N. C., and have received unsurpassed accommodations at every point; therefore be it

Resolved, That the cordial thanks of this entire party be heartily extended to the above corporation for their courtesy and kindness throughout.

Resolved, That special thanks are due to W. A. Turk, of Washington, D. C., general passenger agent of the Southern Railway; to S. H. Hardwick, Atlanta, assistant general passenger agent, and to A. S. Thweatt, of the New York, Eastern passenger agent, for the general plan and arrangement of our itinerary.

Resolved, That we particularly desire to thank Mr. Geo. C. Daniels, New England traveling passenger agent of the Southern Railway, who accompanied us on our entire trip, for his courteous, tireless and unceasing attention, and we do most sincerely congratulate the Southern Railway Company on having such an efficient and obliging agent in their service.

Those of the party who attended the convention of the National Electric Lighting Association in Montreal, and remember the hospitality and courtesy extended to guests on that occasion, anticipate much pleasure in visiting that city next year as members of the Street Railway Association. May the meeting be as successful and agreeable as that at Atlanta is all that one need wish.

What Helped Make the Convention Memorable.

MR. ARTHUR S. PARTRIDGE, of St. Louis, had a useful little advertisement in the form of triangular lead pencils.

A NOVEL ROLL-BLOTTER was given out by the Sterling Company, of New York, as a reminder of the convention.

"JIM" GODFREY, of the New York Insulated Wire Company, put in an appearance early, and was as much sought after as ever.

THE R. D. NUTTALL COMPANY, of Allegheny, Pa., had a comprehensive and artistic exhibit of their well-known specialties.

F. A. MAGEE carried the banner for the universally known house of The E. S. Greeley & Co., of 5 and 7 Dey street, New York.

WILLIAM S. SILVER & CO., of 26 Cortlandt street, New York, presented visitors with glass pens which met with popular approval.

CARLTON & KISSAM, the street car advertising firm, distributed among the delegates an artistic and useful gift—a pocket knife.

MUNSON BELTING was well displayed. Much of the business done by this company comes from electric railway and electric light companies.

THE ST. LOUIS CAR COMPANY gave away "Snap Shots of the World's Fair," a collection of some of the best views taken at the Chicago Exhibition.

THE STERLING SUPPLY & MANUFACTURING COMPANY had a very effective exhibit of their many specialties and gave away a unique souvenir.

THE "TRENTON TROLLEY WAGON" was kept in practically continuous operation to show its many excellent points. This wagon is certain to have a large sale.

MR. JOHN W. OSTROM, of the Pennsylvania Steel Company, Philadelphia, pleased the gentlemen with some very choice cigars, each enclosed in a glass tube.

LEWIS & FOWLER, a name so long among the leading street car manufacturers, displayed the "Acme" Car Jack that received more than ordinary attention.

MR. W. P. SEGUINE, manager of the Railway Department of the Frost Veneer Seating Company, of New York, presented very pretty celluloid calenders at the convention.

THE INTERNATIONAL REGISTER COMPANY, of Chicago, had one of the most effective fare register displays, and Secretary A. E. England received many compliments.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, O., displayed a line of overhead material that attracted considerable attention. G. R. Scrugham was in charge.

SMITH OF NEW YORK, whose exhibit adjoined that of

FULTON FOUNDRY EXHIBIT.

Benedict & Burnham, made a very good display of headlights and electric lighting clusters for street cars.

THE JOHN STEPHENSON COMPANY, through Messrs. J. A. Tackaberry and D. W. Pugh, distributed a number of pretty patent tape measures, which were much appreciated.

THE MEAKER REGISTER, manufactured by the Maeker Mfg. Co., of Chicago, had President Maeker as its sponsor, and as was to be expected, he did the thing up in proper style.

H. W. JOHNS MANUFACTURING COMPANY made a comprehensive display of their insulating material. W. F. D. Crane, Henry G. Issertel and W. H. Gould were in constant attendance.

MR. JAMES F. M'LAUGHLIN and Mr. George Lord of Philadelphia exhibited a conduit system, the invention of Mr. McLaughlin, and for which Messrs. McLaughlin and Lord made great claims.

MORRIS, TASKER & COMPANY, of Philadelphia, were in evidence in their chocolate colored price list of electric light and trolley poles. Engineer S. B. Wheeler made a splendid representation.

F. A. ANGEL, of the National Malleable Casting Company, Chicago, showed a line of malleable castings of overhead material, rail braces, rail chairs and a line of general castings for street railway work.

M. E. BAIRD, general agent of the Eddy Electric Manufacturing Company, of Windsor, Conn., was one of the busiest men at the convention. His company is doing a big business and certainly deserves to.

A FAVORITE RESORT FOR WEARY DELEGATES.

CRAWFORD'S STREET CAR FENDERS, manufactured by the R. A. Crawford Mfg. Co., Pittsburg, Pa., were well exhibited by the inventor, and closely examined by different managers.

J. S. PARTRIDGE had a neat display of carbons manufactured by the Partridge Carbon Company, of Sandusky, O. Mr. Partridge cannot help but make customers even without half trying.

"OKONITE" was, as usual, well represented. Capt. Willard L. Candee, who was present in person, seems to grow more popular with the march of time, while Okonite keeps a close second.

W. F. NEWBERT came all the way from Chicago to remind the delegates that Griffin car wheels could be had at the old stand. Mr. Newbert's address is now the Western Union Building, Chicago.

THIEL'S DETECTIVE SERVICE was represented by Proprietor G. H. Thiel in person, and Mr. C. M. French, manager of the Chicago office. This bureau make a specialty of work for street railway corporations.

THE SCARRITT CAR SEAT COMPANY, of 941 Rookery, Chicago, sent Mr. H. O. Nourse, who kept his firm's name to the front. His "Coons in the Corner" were highly appreciated by members and lady visitors.

WM. HAZLETON, 3rd., enjoyed the distinction of being the only representaitve of a foreign enterprise. He now represents Les

ONE OF THE MOST COMPLETE DISPLAYS.

Etablissements Arbel, of Loire, France, manufacturers of wrought iron forged center for car wheels.

THE GUARANTOR'S LIABILITY INDEMNITY COMPANY, of Pennsylvania, whose head office is at 435 Chestnut street, Philadelphia, presented the delegates with a card case of black as a souvenir of the convention.

"THESE ARE OUR JEWELS" was the simple sentence on an artistic pamphlet that introduced the reader to some of the notable plants equipped with Heine boilers. Col. E. D. Meier, president of the company, was present in person.

THE CHICAGO TRUCK COMPANY were unfortunate in that the railroads failed to get their truck to the building on time. However, vice-president George H. Graham was on hand, and did much to increase the fame of this truck.

COOK, FROM CHICAGO, whose initials are W. J., and whose name every one knows, represented the McGuire Mfg. Co., and attended to its exhibit, while Philadelphia Agent Hanna did much to advance the renown of this truck.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Ct., rather broke the record for Convention exhibits by erecting a model power station that aroused great interest. Mr. John M. Field was in charge.

"KERITE" insulated wire was ably and effectively represented by F. G. Fuller known to fame as "Pop" Fuller, who

distributed to delegates and distinguished visitors a handsome pocket note book as a souvenir of the occasion.

E. C. DARLEY came from St. Louis to impress upon the delegates the good qualities of the Rankin & Fritsch engine. This is the giant engine in use at the power house of the Atlanta Consolidated Street Railway Company.

GARTON & KNIGHT MANUFACTURING COMPANY, of Worcester, Mass., distributed neat invitations to visit their store on West Alabama street to examine a line of their belting, and many of the visitors accepted. Mr. Harry W. Anderson was in charge.

STILLWEL-BIERCE & SMITH-VAILE COMPANY, of Dayton, O., had an artistic display of pumps, and of the new friction clutch just placed on the market. The exhibit was made by Mr. J. W. Taylor, southern agent, and attracted much attention.

Model Power Station.

THE WIGHTMAN BLOCK SIGNAL for electric railways, was shown in operation. This is manufactured by Wightman & Co., of Scranton, Pa., and consists of signals practically the same as electric signals on steam roads. It was unusually interesting.

BENEDICT & BURNHAM, as every one admitted, made one of the best displays of rail bonds and railway wire ever attempted at a street railway convention, and in consequence had the satisfaction of a visit from nearly every delegate.

EDWARD E. HIGGINS, a familiar and popular convention character, journeyed from New York to greet old friends. As is well known, Mr. Higgins is now an expert in street railway values and economies, with an office at 26 Cortlandt street, New York.

A FLEXIBLE ADJUSTABLE BRACKET of new and improved design, was described in suitable literature circulated by the Wrought Iron Bridge Company, of Canton, O. Many inquiries were made for a representative of this well-known firm, but he did not arrive.

THE GENETT AIR BRAKE was especially prominent. The musical toot of its whistle on the cars equipped and running, its handsome display in the hall, and the hustling of General Manager E. J. Wessels kept every one reminded that air-brakes were here to stay.

THE NILES TOOL WORKS had one of their great tools so arranged that visitors could not help but see all of its features. Many were pleased to examine an exhibit from a firm which has supplied so much machinery to those in the electrical industry.

"THE BOOSTER SYSTEM" and other electric railway information was supplied by Mr. J. H. Vail, of the Electrical and Mechanical Engineering and Trading Company, of New York. If any one missed this choice bit of literature he should now send for a copy.

THE NEW HAVEN CAR REGISTER made an unusually handsome display. Vice-President and General Manager F. Coleman Boyd was kept busy "ringing up" to show the features of his clever device, in addition to handing out a much-valued souvenir—a mirror paper-weight.

MR. A. L. REGISTER, representing Pepper & Register, of Philadelphia, and one of the rising young men of the industry, grasped the hands of many who have long known him. The Technic Electrical Works, in which he is interested, was directly represented by H. T. Stewart.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY had a very graphic exhibit of their magneto telephones, and Manager Stitch proved himself a capital convention worker. It will be strange if many orders do not follow as the result of his energetic work.

THE STREET RAILWAY REVIEW furnished a good example of its usual Western enterprise in distributing among its friends at the convention a very handsome souvenir number which was well gotten up and reflected great credit on the representative of the street railway interests in the West.

THE WALLACE ELECTRIC COMPANY, of Chicago, in the person of Mr. Max Berg, had a very kindly reception from every one. Their display consisted mostly of a handsome pamphlet describing Wood's street railway specialties, Habirshaw wire, etc. Hundreds of copies were well distributed.

MR. CHAS. O. LENTZ did the honors for the Graham Equipment Company, of Providence. The Graham truck has made great headway of late, one of the most gratifying orders being for 8 trucks given by the Consolidated lines of Atlanta; 4 of these were in service during the Convention, the others being on the ground.

JACKSON & SHARP, one of the oldest car-building firms in the world, which has recently taken up street car building, were represented by President J. H. Jackson and Mr. Geo. E. Pratt. Several of the cars manufactured by this company were in service during the convention. That they were admired goes without saying.

MR. RICHARD O. HEINRICHS, in a neat bit of literature issued by the Weston Electrical Instrument Company, of Newark N. J., announced that he was ready and would be happy to discuss the merits of this prominent type of measuring instrument. If you didn't get one of these little pamphlets send for a copy; it is interesting.

THE FALK MANUFACTURING COMPANY, of Milwaukee, showed great wisdom in sending Mr. G. Hoffman to the Convention, for he proved to be one of the greatest hustlers of the meeting. His exhibit had a continual stream of visitors, and his arguments were just the thing. His trolley will hereafter be much better known.

Popular Overhead Material.

THE FIBERITE COMPANY, and the Mason Electric Company had made arrangements for the joint display of a very handsome line of Medbery overhead specialties. To their bitter disappointment they found that the shipment had been delayed, and in

consequence the many callers did not see specimens of this well-known material. The Medbery insulation has long been popular with street railway managers.

THE VAN DORN AUTOMATIC DRAWBAR was exhibited by the inventor, Mr. W. T. Van Dorn. This device has been seen at all the recent street railway conventions, and has become a standard. One of the latest orders taken by the Fitzgerald-Van Dorn Company was given by the Metropolitan West Side "L" road of Chicago. Their address is Lincoln, Neb.

THE WADHAMS OIL & GREASE COMPANY, of Milwaukee, Wis., happily remembered from the convention in that city last year, made a good display of Wadhams' curve grease,

feet. It embraced a line of sample Shanghai and T-rails for paved streets on steel ties, and also girder rail work in all varieties. President Paige was himself in charge. Their tribute to the souvenir collectors was a handsomely nickeled section of rail for a paper weight.

THE STIRLING WATER TUBE BOILER had a most unique exhibit. It consisted of a model boiler in which, through glass openings, the circulation of water (heated by a spirit lamp) was plainly seen. President Degan had no difficulty in securing the close attention of the visitors that came his way. The Stirling, by the way, was recently adopted by the West Chicago City Railway Company, the order being for 8,000-hp.

This Exhibit Created Unusual Interest.

One of the Most Complete Displays of Specialties.

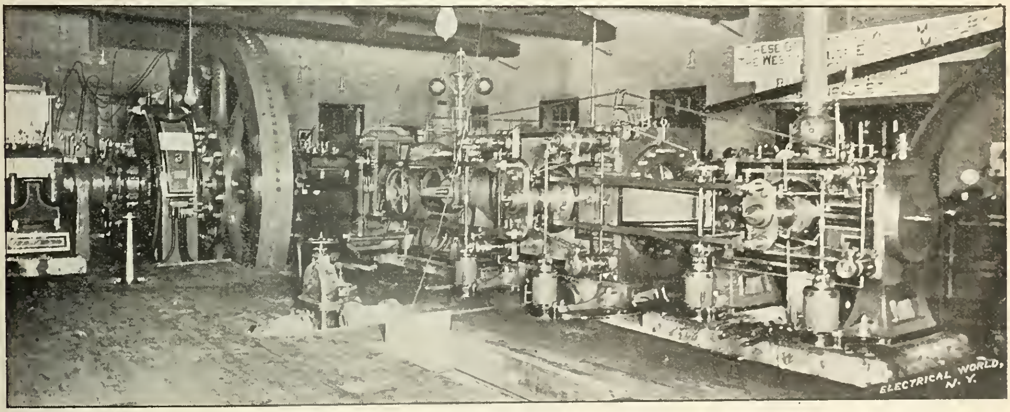
as well as of their high grade dynamo and engine oils. E. A. Wadhams and G. A. Streeter attended to the exhibit and were among the busy workers.

THE "JEWEL" BELTING COMPANY, without which a convention or exhibition of any kind would be incomplete, made a very neat display of dynamo belting. This embraced a section of their 69-inch 3-ply belt that has transmitted 1,540-hp at a speed of 5,260 feet per second. Their souvenirs, handsome snake-skin card-cases, were much sought after and highly prized.

THE OHIO BRASS COMPANY made a very creditable

THE PENNSYLVANIA STEEL COMPANY, of Philadelphia, Pa., which, by the way, was the first firm in the United States to roll a steel rail, had a substantial display of sample rail sections, steel railroad crossings (recently adopted by the Pennsylvania Railway). "T" and girder rails, etc. Treasurer E. M Smith, Manager J. F. Ostrom, C. S. Clark and M. D. Pratt were the representatives present.

THE BASS FOUNDRY & MACHINE COMPANY, of Fort Wayne, Ind., occupied a favored position in the centre of the hall. P. F Leach had matters in charge. His display included a full line



New 750 h-p Unit at Consolidated Power House.

display of their overhead railway specialties. They had a full line of samples, together with a very attractive souvenir, and a particularly good representative in the person of Mr. C. K. King, manager of the company, and a man thoroughly well known for his painstaking and conscientious work.

THE ELECTRICAL REVIEW took advantage of the occasion to distribute to the delegates a special number devoted to street railway interests which contained much interesting and valuable matter. To distinguish this number from one of its regular issues the covers were printed in red ink, which imparted to it a very striking and conspicuous appearance and excited favorable comment on the part of those present.

THE PAIGE IRON WORKS, of Chicago, had the largest exhibit in the building, its total floor space being more than 1,200

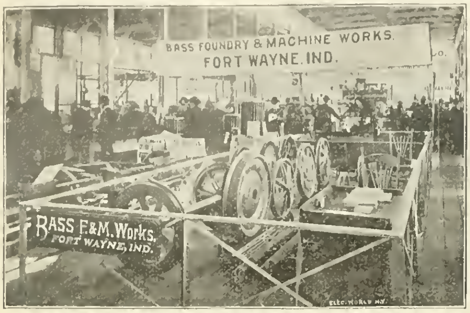
of car wheels. Among them were specimens of the famous "Cushioned" wheels for electrically driven cars, about which much has been said. This firm also make Corliss and other types of engines for power stations.

THE CENTRAL ELECTRIC HEATING COMPANY had a full line of their different types of electrical heaters, and Mr. Edward B. Wyman, manager of the street railway department, had his hands full at the convention and closed several nice orders. As electric heating has been indorsed by the most progressive managers, it is now only a question of the system to be selected.

W. E. HAYCOX, president and general manager of the Fulton Truck and Foundry Company, now of Mansfield, O., was one of the busiest men in the Exposition hall. His exhibit embraced a

motor truck, car wheels, ticket destroying machine and a motor lift in operation. Mr. Haycox discovered during the convention that his firm holds a warm place among street railway men, and is certain to make many friends in the future.

SPERRY'S ELECTRIC BRAKE was certainly one of the principal novelties of the convention. It was in operation on one of the Sperry cars, and was under the personal direction of the inventor, Elmer A. Sperry. L. A. Rogers, general manager of the Sperry Electric Railway Company, circulated one of the brightest bits of literature found at the meeting, in which the Sperry system was clearly described, and in addition did much for the advancement of the company's interest.

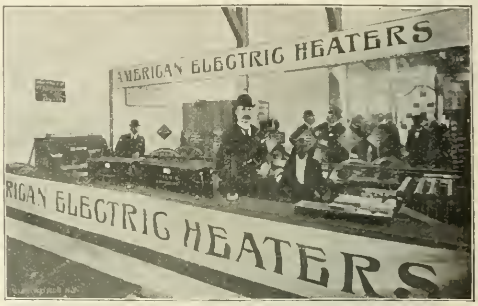


CUSHION CAR WHEELS IN PROFUSION.

CHAS. A. SCHIEREN & COMPANY, represented by young Mr. Schieren, so popular at all conventions, gave away one of the neatest memorandum souvenirs at the convention. It was a handsome book, on the celluloid covers of which was a picture of Schieren & Co.'s Bristol, Tenn., tannery, where all their oak tanned belting is prepared. This establishment, situated but a short distance from the convention city, has a capacity of 200 hides per day and is rated one of the largest tanneries in the world.

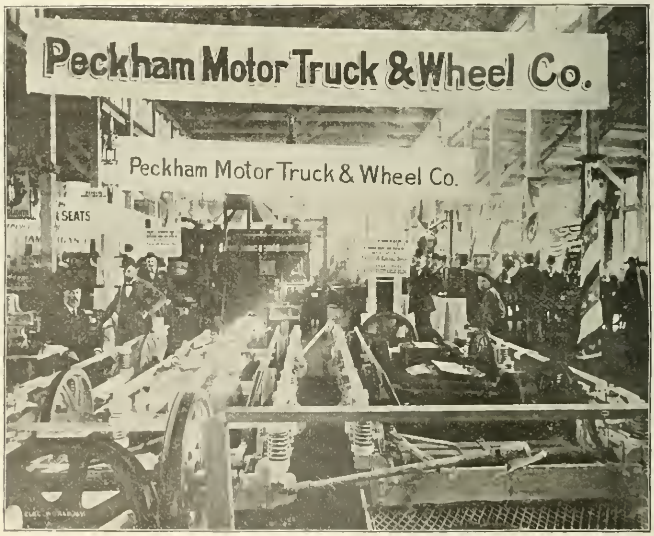
THE CONSOLIDATED CAR HEATING COMPANY had a well arranged and complete display of their car heaters. The form of this type of electric heater is already well-known to our readers. Inventor McElroy volunteered the information, however, that although his company gave a two-year guarantee they had apparatus in for the past three years that was giving excellent satisfaction, and were now able to give that guarantee. Western Manager E. A. Smith and Engineer H. N. Ransom were also in attendance.

THE STREET RAILWAY JOURNAL this year renewed its custom of distributing to those attending the convention a souvenir edition which was a model of artistic and typographical excellence. Filled with interesting and appropriate matter, handsomely illustrated and printed on heavy paper, it will undoubtedly be preserved by many present as a reminder of one of the most successful and enjoyable meetings ever held by the association. The Journal is to be congratulated on the fine appearance of this souvenir number.



WHERE STREET RAILWAY MEN LEFT CAR HEATER ORDERS.

THE JOHNSON COMPANY, of Johnstown, Pa., were, as usual, one of the best represented companies. Their exhibit embraced samples of their steel rail construction, as well as one of their new and improved Dupont Trucks about which much has been said in praise. The immortal three—Coolidge, Littlefield and Evans—were everywhere, and no delegate in need of rails or trucks escaped them. The "Major" was the central figure of Atlanta during the meeting, and startled the Southerners with his chrysanthemum and his wit.



MOST NOTABLE TRUCK DISPLAY.

"MICHIGAN OVERHEAD MATERIAL" was displayed on a neat sample board bearing the legend "A Line of Reliable Material Designed by Practical Men." President Jos. E. Lockwood of the Michigan Electric Company, Detroit, Mich., was present and in charge of the exhibit, which included span, barn, bracket, swinging, and curve ranges, switches, cross-overs, strain plates, section insulators and pull-offs. This company also exhibited a radical

departure in the way of a signal light for electric cars which was much admired.

C-S AUTOMATIC CUT-OUTS were neatly displayed, and graphically described on a card in which it was stated that where these cut-outs are used the fiendish practice of reversing the controller to stop a car, popular with lazy conductors, is impossible for the reason that this magnetic cut-out immediately located the man and the car. The visitors were advised not to use the C-S automatic cut-out "if you don't care to save your apparatus." W. E. Harrington and C. E. Bibber did the right thing for every one.

aware of the fact that Peckham trucks were in use under the Sperry exhibit car, and the great long Jackson & Sharp car, both in service.

JOHN G. BRILL, than whom there is no better known or more popular man in the car building industry, and whose company is always prominent at events of this kind, had much to do, as his exhibit was very complete. In the hall was shown a sectional end of closed car in natural wood, removable vestibule, brake ratchet lever and brake ratchet windlass, rotary gong, track scraper, sand box, gates, life guards and fender, all of Brill's latest pattern. One

WIRE AND RAIL BOND BOOTH.

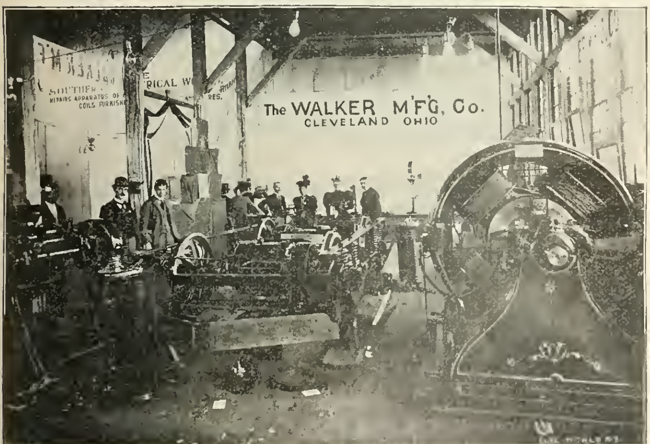
NEIGHBORLY DISPLAYS.

THE CARD ELECTRIC COMPANY, of Mansfield, O., had a very well arranged display in a good location. It consisted of one 35-hp double motor equipment mounted on trucks, and another 25-hp motor open for inspection; multiple series controller device for turning down commutator without taking commutator out of motor case; new fuse plug and new magnetic switch. Inventor Card, President Reid Carpenter and Superintendent J. F. Card were in constant attendance, and were all kept busy answering the hundreds of questions concerning what has been termed "the newest comer into the motor field."

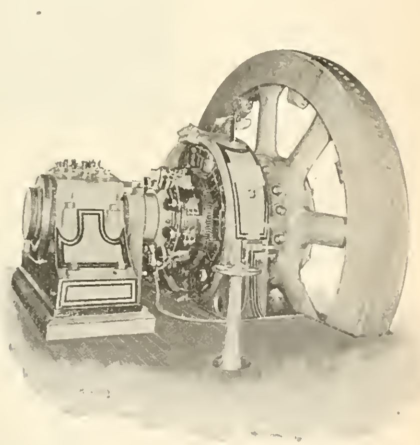
PECKHAM'S TRUCKS were much in evidence. The literature devoted to this popular truck was unusually handsome and com-

Eureka Maximum Traction and one No. 21 B truck were shown. The street exhibit consisted of an 18-foot car on No. 21-truck, a 20-foot car on Eureka truck, and a combination open and closed car, all in operation. The representatives of the firm in addition to Mr. Brill were F. C. Randall, western selling agent, S. M. Curwen, M. E. Curwen, Geo. M. Haskell and Wm. H. Heulings, Jr.

MR. A. J. WURTS, at the Westinghouse Company headquarters at the Aragon Hotel, performed some striking experiments to illustrate the principles upon which is based his system of protection against lightning, showing among other things how to make lightning and how to handle it. Having it ready made in the clouds he showed how it could be controlled and also showed how the appliances heretofore



THE BRIGHTEST EXHIBIT AT ATLANTA.



750-HP GENERATOR AT CONSOLIDATED POWER-HOUSE.

plete, while the display in the exhibition was very interesting. It included one standard and one extra long centilever extension truck; also interchangeable wheels, wheels on axles, and independent, flexible gears and a model of a truck. President Peckham was himself kept constantly on the go attending to details and talking with delegates. His staff consisted of W. E. Cook, engineer, and W. H. Wilkinson, superintendent. In addition the visitors were kept

used for that purpose might accidentally do some good but how they probably might do no good whatever. He made a disruptive discharge pass across a five-inch space over a surface, that would not pass through an air space of more than about three-quarters of an inch, and illustrated other peculiarities, eccentricities or vagaries, whatever name is proper, that govern or do not govern the manner in which disruptive discharges take place along a line, for sometimes

they take place where an ordinary man would suppose, while sometimes they go where nobody would ever expect to find them except possibly Mr. Wurts himself, who has made the erratic freaks of lightning a special study, both in the laboratory and in the field.

THE WALKER MANUFACTURING COMPANY, of Cleveland, certainly had the most attractive exhibit in the building. Happily situated by the main entrance, it was admirably planned and well managed. It consisted of a 200 hp generator, complete motor truck with two 30-hp spring mounted motors, two series parallel controllers, rheostats, lightning arresters, fuse boxes, cut-outs, switches and everything that goes with an electrical equipment. One of the best features of the display was the demonstration of the value of spring suspension. a feature that greatly reduces the pound at rail joints. In addition to this the company distributed a handsome pamphlet illustrative of the lines now equipped with Walker apparatus, and of the immense factory at Cleveland. Inventor Sydney Howe Short was in charge. Manager. W. H. Bone was busy at all times, while H. McL. Harding, an old street railway man, met friends at every turn. Other representatives of the company were B. M. Barr and Jas. Atkinson, selling agents at Cleveland, and the Kohler Bros., Chicago agents. Altogether the Walker Company made a most pleasing impression at the Convention.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY needed no other exhibit than that afforded in the powerhouse of the Consolidated Company, to which place the entire convention adjourned on Thursday where they saw a 750-hp Westinghouse generator started up successfully. The illustration of this, given elsewhere in this issue, afford the best possible description of it. It is needless to say that the delegates were highly pleased, and many were the compliments showered upon the Westinghouse system. A notable feature of their convention efforts was the lecture given by Electrician A. J. Wurts in their room at the Aragon; Press Manager Heinrichs was busy as usual looking after the interests of his company. The other representatives were Wm. F. Zimmermann, assistant general manager, New York; W. C. Clark, general agent, Pittsburgh; B. F. Stewart, district manager, Chicago; G. Pantaleoni, district manager, St. Louis; C. A. Bragg, district manager, Philadelphia; D. A. Tompkins, district manager, Charlotte, S. C; J. A. Rutherford, salesman, Pittsburgh, and I. R. Gordon, salesman, Charlotte.

THE GENERAL ELECTRIC COMPANY, as usual, had a very artistic and comprehensive display of street railway devices in the centre of the hall. This consisted of a full line of overhead material, underground feeder tubing, different forms of controller, generator and feeder panels, current cut-outs, the "Thomson" arc lamp, and the Thomson recording wattmeter, together with quite an extensive line of literature. The best feature of the General Electric convention display, however, was the apparently great number of G. E. 800 motors in use on the lines of the Consolidated. It seemed as though every car bore the statement that this type of motors was in service on that particular car. Its corps of representatives was large and effective. W. J. Clark was in charge, and was ably [illegible]ted by J. K. Lovejoy, manager of the supply department, H. C. Wirt, assistant; A. K. Baylor, assistant to Mr. Clark; T. P. Bailey of the Chicago office; Geo. D. Rosenthal, St. Louis office; W. B. Potter, H. J. Crowley, H. H. Corson, D. B. Bullen, A. F. Giles and J. E. Hoffman. The headquarters of the company at the Kimball House during the convention was one of the most popular corners in Atlanta.

WOODRUFF AND ELLIOT, of the Consolidated Street Railway Company, were much complimented upon their success in installing and starting up the new 750-hp engine and generator during the convention and in presence of a large body of delegates. The engine and dynamo do not form a direct connected equipment in the sense of having the dynamo shaft and the engine shaft coupled. In this case the armature of the generator is built upon the main shaft of the engine, which is of the Corliss compound condensing type, the fly wheel of the engine being also on the same shaft. The shaft was made in St. Louis by the Rankin-Fritsch Engine Company and the armature in Pittsburgh by the Westinghouse Company. When the separate contracts were made nothing was said about who should put the armature on the shaft. The engine people did not wish to assume the responsibility connected with undertaking it. It would be expensive to ship the shaft to Pittsburgh to have it done there, and Messrs. Woodruff and Elliott finally determined to undertake to put the armature on the main shaft in Atlanta. This was accomplished, and the opinion of experts who examined the work was that it has been quite as well done as it could have been in a big shop with ample facilities, such as no power house could afford. The starting up of this big unit was one of the events of the convention and was celebrated by a lunch given by the Consolidated company to about one hundred invited guests, being served immediately after the machinery was put in operation, by the year-old son of Mr. Joel Hurt.

AMONG OTHER COMPANIES represented at the Atlanta convention, some of whom, however, had no exhibits, were: The American Electric Manufacturing Company, J. F. Gerliman, St. Louis; Abendroth & Root Manufacturing Company, P. McLaren, general manager, New York; Buckeye Engine Company, G. A. Barnard, Salem, O.; G. L. Colgate, New York; C. L. Cornell, Hamilton, O.; Chapman Valve Mfg. Co., E. L. Ross, Indian Orchard, Mass.; Car Equipment Company, E. H. Allen, Philadelphia; Columbia Incandescent Lamp Company, J. H. Rhotehamel, president, St. Louis; Dorner and Dutton Manufacturing Company, J. L. Pugh, Cleveland, O.; Electric Railway Equipment Company, S. J. Nick, Cincinnati; Georgia Equipment Company, J. Regenstein, W. Brooks, C. E. Fairbanks, Atlanta, Ga.; Hoppes Manufacturing Company, W. H. Fisher, Springfield, O.; Morris, Tasker & Company, C. F. Flanders, S. Bowman, Philadelphia; New York Electric Works, C. W. Van Fleet, New York; New Process Raw Hide Company, A. C. Vosbaugh, Syracuse; New Haven Car Register Company, F. C. Boyd, J. S. Bradley; Pettingell-Andrews Company, F. X. Cicott, Boston; Rochester Car Wheel Company, F. D. Russell, Rochester, N. Y.; Robinson Radial Car Truck Company, W. Robinson, Boston; Standard Underground Cable Company, F. G. Degenhardt, Pittsburg; Stanwood Manufacturing Company, F. H. Stanwood, Chicago; St. Louis Register Company, J. W. Allison, St. Louis; Vacuum Oil Company, E. A. Record, Boston.

The Johnson Company's Space—Where Notables Gathered.

The T-Rail Track Construction of the Terre Haute Electric Railway.*

BY RUSSELL B. HARRISON.

The first T-rail was laid by the Terre Haute Electric Railway in the fall of 1890 and with a little judicious explanation of its merits to the Mayor and Aldemen met with no opposition. This was a 40-pound rail, laid on oak ties 5x7x7 inches, three feet from centre to centre. It was found that planking was unnecessary and that gravel was much more satisfactory.

In 1892 the city began paving the streets and their experience with the T-rail had been so satisfactory that it was decided to continue its use. About this time the Illinois Steel Company brought out their sixty-pound Shanghai T-rail, and as it was five and three-quarters inches high, permitting paving without chairs and direct spiking of the rail to the ties, it was very promptly adopted and ordered. Carefully selected oak ties 5x7x7 were used.

In the fall of the same year it was necessary to lay T-rails in an asphalted street. The asphalt was brought up to and in contact with the rail on the outside for the entire distance of half a mile. On the inside for the first half mile the vitrified brick used with the corner cut off on a sloping angle, was used to give flange space, and between the two ends of the brick asphalt was used in the regular way. On the last mile the Haydenville blocks were tried but they were found not to have the wearing qualities of brick.

The company also had experience with T-rails in streets paved with bricks.

Attention was then given to the following improvements. (1), to use a heavier rail with wider head; (2), to substitute metal glass-ties for wood; (3), to secure greater rigidity and evenness in rail ends; (4), a firm and permanent hold on the rails without the use of nuts and bolts; (5), in paving, a better brick and of such shape as would provide better flange room and contact with the web of the rail. These changes brought the company to an all steel T-rail track.

A description of this modern track construction in detail may prove of interest.

Rail—When the Illinois Steel Company brought out the seventy-two pound Shanghai T-rail, which was an improvement both in weight, strength and in the width of the head of the rail over sixty Shanghai T-rail of same make, it was immediately adopted as the company's standard and was used in our latest and best T-rail track construction. The rail is six inches high, the base is five inches wide, the top or head is two and three-eighths inches in width. The web from where the turns begin is three and one-half inches. The long web permits the rail to rest on the ties and brings the top of rail to proper level for paving with brick, asphalt or granite blocks. In this track the rails are laid broken jointed. The seventy-two pound rail has a wider head which gives better contact, and wider bearing service for the wheels. The edges of the wheels do not nick or chip out as with the lighter rails with narrower heads. Experience with the narrow head rails demonstrates that by wear an outer flange is formed on the wheel and that this outer flange is very destructive to the life of special work and the wheel. The wider rail head is also better for gravel or macadamized streets, as it gives no opportunity for the stones lying adjacent to the rail to nick the outer edge of the tread of the wheel.

Foundation—The foundation of a track is to a larger degree than any other part responsible for its wearing qualities, and this fact has not been lost sight of in our work. Good rails, ties and joints cannot alone make a track or properly sustain it so as to keep it level and give good wearing qualities; therefore under the all-steel track it was determined to place a heavy foundation of the best material. After the necessary excavation the ground was rolled with a heavy fourteen-ton steam road roller. Then eight inches of broken stone concrete was placed in position and allowed to set. Then the rails, ties and joints were distributed and connected together and when the track is completed it is brought to the required grade or level by putting blocks under the rails at intervals to bring track to proper grade. Then four inches of broken stone concrete is tamped under the ties and under the rails. After the tamping process is completed the inequalities of the surface are filled with concrete and the whole leveled up with concrete over the top of the ties and pounded to a level surface with a wooden rammer and allowed to set.

Ties—The ties are steel and double corrugated and heavily coated with tar while hot and being made, are two inches high, seven inches wide and seven feet long for straight line work, and were laid fifteen inches between centres. For special work the ties vary in length as the necessities require, up to twenty feet or more. The metal of the tie is one-half inch thick. These ties were manufactured by the Daniels Steel Tie Company, of Youngstown, O. The rails rest on and are fastened to the ties by clamps with off-sets to fit the base of the rail. These clamps are secured and adjusted to the top of the tie by special made bolts with oval shoulder and inserted from bottom of tie with the head below and the nut on top, which permits a powerful box wrench being used to draw the nuts on bolts to a permanent position. In using these steel ties in connection with the Wheeler rail joint a mechanical difficulty arose, but was overcome in the following way after some study: The Wheeler joint has a thickness of three inches below the rail base, and in laying track with broken rail joints a straight tie would not answer. At first we thought it would be necessary to use a wooden tie under rail joints, but by devising a special tie, we were able to have them all of metal. The special steel tie for use under joints was adjusted to the necessary levels, by bending it down in the centre three inches by an easy off-set. In laying the track these special ties were easily placed in position and gave perfect satisfaction. The clamps and bolts were the same as on straight line work.

Joints—A great deal of attention was given to the subject of securing a good rail joint for this all-steel track, and after examining many devices we selected the Wheeler rail joint made at Marion, Ind., as it did away with the bolts and nuts, and embodied the best of all mechanical principles—that of the wedge. These joints at that time had not been made for Shanghai rails or for steel ties, but I overcame these difficulties by designing a new joint to be used with these rails and ties, and secured in this new pattern more bearing surface on the tie, by having the bottom of the joint made to fit the corrugations of the tie. The joint consists of two parts, one of which is keyed on to the other. The larger or heavier part used on the outside of rail has two lugs, that fit in the angle joint holes nearest the ends of rails. After it is placed in position, the lighter part is keyed on with a large maul and it holds the rails rigid. Then the tie is placed under joint and is fastened to it in the regular way, with the exception that the clamps have longer off-sets, the holes in the ties for the bolts are also wider apart, on account of the width of the base of the joint. The joint has corrugations on each side at right angles to the rail, which gives it great strength. The joint is made of the best malleable iron and weighs thirty-two pounds complete.

Bond and Supplementary Wire—Iron wire, having proved unserviceable and unsatisfactory, the heaviest copper wire was used in connection with this steel track. Double bonds of No. 0000 copper wire were used at each rail joint, one in the upper and one in the lower part of the web of rail. These bonds were soldered and connected to the No. 00 tinned copper supplementary wire, that has been adopted as standard.

Paving—When the foundation is completed and the track set in it, as just described, nothing remains but the paving to complete the track and street for use. The all-steel track was laid on 9th Street, a business street leading from Wabash Avenue or Main Street to the Union Depot, and brick was, therefore, selected for the paving material. As the use of Haydenville block has been abandoned and the angle, nose-cut brick did not touch the web of the rail, I designed a special shaped brick that has many advantages, combined with the same wearing qualities as the brick on each side of the tracks.

Drainage—In the centre of each track, at the lowest point in the grade of each street, an eight-inch sewer pipe was laid to the sewer. Over the top or opening of this pipe, in the center of the street, is placed a small catch basin surmounted by a special made iron grating. The water flowing down the track and along the side of the rails, is thus rapidly removed and a simple and effective drainage secured.

Injury to Track by Vehicles and Heavy Teaming—On our track, which is standard gauge, four feet eight and a half inches wide, heavily loaded vehicles cannot drive along it and get the benefit of the smooth metallic surface as in the case with girder rails. This condition is a great improvement, and makes a saving in many ways. First: It saves an immense amount of money in repairing the injury and wrenching to track, and rapid wear and tear thereto caused by vehicles, and particularly heavily loaded wagons running in and out and driving along the track. Second: It permits a quicker and more frequent service.

To further prevent heavy teaming along the flange spaces of our track, and at the same time make the wear and tear on the street paving, which we are required to maintain, a minimum, an ordinance was passed by the City Council "Regulating Heavy Hauling Over and Through the Improved Streets of the City of Terre Haute."

* Abstract of a paper presented at the Atlanta Meeting of the American Street Railway Association.

Can the T-Rail be Satisfactorily Used on Paved Streets?

In presenting his report to the Atlanta meeting of the American Street Railway Association Mr. Strathearn Hendrie stated that the word "satisfactorily" had been considered as applying to the point of view of the city and driving public as well as that of the company. The tendency of the larger cities, and in fact of all cities in this country during the past 10 years or more, has been toward smoother and better paved streets which has resulted in a demand, both by the public and city officials, for improved forms of rails. Following the example of foreign cities many city officials have forced the street railway companies either to use the English groved rail or its American modification, neither of which, however, has proved satisfactory to the railway companies. For the street railway man questions of price, joints, quick delivery, competition, coal and construction combine to recommend the T-rail. The old argument for the tram head—that the steel paving for three inches is the cheapest in the end—no longer holds good, and wagon traffic goes, where it belongs on the side of the street. The suggestion of a T-rail is generally startling to the average citizen, alderman and city engineer, but their idea of such a rail is that used by steam roads and projecting four or five inches above the street. It is necessary to convince them that there is more than one way of putting a rail in the street.

As an appendix to the report a list of 26 cities in which the T-rail is used is given with remarks thereon, from which it is apparent that the general concensus of opinion of these roads, and of the officials of the cities in which they run, is that if 100 yards of T-rail can once be laid with good paving neither the officials nor the citizens would permit the use of anything else in the future. The paving is perhaps the most important point. Modern street railway construction and street paving imply broken stone, concrete or other solid foundation, a high girder or T-rail and a brick, asphalt or granite surface to the street in larger cities, or cedar blocks, cobble or macadam in the smaller ones. Asphalt or macadam can be paved as easily to a T-rail as to any other. They should be laid flush and room should be made for the flange by running a railroad freight car or other car having a larger flange than the street car over the track before it is open for traffic. Bricks are now molded by many manufacturers to fit girder and T-rails. Whether it is more expensive to chip the corner of granite or Medina blocks, or to leave them intact a short distance from the head of the rail and fill the place made with asphalt, creosoted wood or concrete is an open question.

It may be useful in arguments with city officials in favor of the T-rail as against a grooved girder to insist that the T-rail is a girder rail with a head, differing less from that of the grooved girder than this does from the tram or centre bearing head; also that the substitution in this country of the steel brace and upright member of a girder for the wooden stringer took place before the introduction of the grooved rail, and was due to entirely different causes. The girder is an established fact; its grooved head, it is hoped, is merely a passing fancy.

A System of Taxation.

Mr. Allen Ripley Foote read a paper before the Atlanta meeting of the American Street Railway Association, on taxation, in which, after the economic principles concerned are discussed, a system of taxation is proposed.

The system provides that all property, including exchangeable products upon which labor has been expended and the ownership of which is protected by law, shall be assessed for taxation at full value, but that securities representing the ownership and value of property shall not be taxed. No other than a property tax shall be levied upon any industry, business or vocation. The Legislature may exempt the whole of any class of property from taxation, and special assessments may be made for special benefits, accruing from public improvement, upon all property securing an increment of value by such improvement. The system also provides a method for carrying out its details.

An Atom of Electricity.

According to a recent determination of Prof. Richarz, the smallest possible quantity of electricity, which may be termed an atom of electricity, is such that 430 multiplied by a million three times, that is, by the cube of a million, will give the number of these atoms contained in a coulomb. That such a thing as an atom of electricity exists is the opinion of no less an authority than Prof. Von Helmholtz.

Classification of Street Railway Expenditure.

At the Atlanta Convention, Mr. H. I. Bettis submitted the report of the committee on "A Standard Form of Street Railway Accounts" which includes a classification of expenditure. The report states that while the classification is not sub-divided to the extent that some might think desirable, yet it is sufficiently so for practical purposes, and that any further division would only serve statistical and not business ends.

The classification is under two general heads, "Construction and Equipment" and "Operating Expenses," the former comprising twenty items and the latter thirty-two; operating expenses are under four sub-heads, "General Operating Expense," "Transportation Expense," "Maintenance of Way and Buildings" and "Maintenance of Equipment." Below we give the various items, with explanatory notes:

CONSTRUCTION AND EQUIPMENT.

1. Superintendence and Organization Expense.—Salaries of superintendent of construction, assistants, wages of clerks and others employed in the offices of this department. Expense of the office, furniture, fuel, lighting, supplies for office, miscellaneous and personal expense of superintendent and assistants while on business. Includes stationary and printing for this department. Also all expenses of organization not coming under either of the following heads:

2. Engineering.—Wages and expenses of engineers and draughtsmen on preliminary and construction work.

3. Right-of-Way.—Salaries and expenses of right-of-way agent, together with payments for rights of way, easements, franchises and pole rights.

4. Building Construction.—Cost of buildings; car houses, stations, offices, store houses, power house, repair shops, wharves, coal sheds, etc., etc.; also furniture and fixtures for the same. To this account should also be charged the cost of land occupied by the buildings mentioned. Real estate (land and buildings thereon) not used by the road for actual operation must be charged to Real Estate Account.

5. Track and Roadway Construction.—Includes the expense of grading, surfacing, ballasting, ditching and paving; the cost of rails, rail chairs, ties and stringers, tie rods, joint fastenings, track spikes, frogs and switches, supplementary wire, tie wires, channel pins, solder and miscellaneous track material; also the cost of distributing and laying the same, with the supplementary wire and its connections.

6. Overhead Construction.—Cost of poles and setting; putting up trolley, feeder and guard wires, including cost of wire and all devices for overhead construction.

7. Car Equipment.—Cost of cars built or purchased, including the cost of trucks, wheels, motors, upholstering, painting, lettering, varnishing, &c.

8. Snow Plows and Sweepers.—Cost of snow plows and sweepers built and purchased, including the electrical equipment for the same.

9. Power Station Equipment.—Cost of steam plant, engines, boilers, pumps, piping, shafting and belting, dynamos and switchboard equipment, together with installation of the same.

10. Tools and Machinery.—Cost of tools and machinery for repair shops, car houses, &c., and expense of setting and placing in running order.

11. Improvements and Betterments.—All expenditures which improve the *original plant*, and of which a portion should be charged to operating, and a portion to construction expenses.

12. Real Estate.—All land and buildings thereon purchased as an investment and not used by the road for actual operation.

GENERAL OPERATING EXPENSES.

21. Salaries of General Officers and Clerks.—In this account are included the salaries of the general officers; the heads of departments connected with the supervision and management of the general business of the road. Salaries of division superintendents and assistants may also be charged to this account. By general officers are meant officers in charge of departments, and whose jurisdiction extends over the entire road. This account embraces the salaries of all clerks in the general offices, clerks for heads of departments, and all clerks not herein after mentioned.

22. Miscellaneous Expense General Offices.—The expense of heating and lighting the general offices; wages of porters, messengers, etc., telephone service and all miscellaneous supplies and expenses of the general offices, including the cost of all stationary, books, paper, stamps, pens, pencils, etc.; also cost of all printing of

blanks, circulars, statements, tickets, and the cost of advertising.

23. Insurance.—Includes cost of insurance on property of the company, and against injuries to employees, and all expenses of collection.

24. Legal Expenses.—In this account are included the salaries, fees and expenses of attorneys, witness fees and other court expenses.

25. Injuries and Damages.—Expenses on account of persons injured and property damaged, with payments of claims, are all chargeable to this account. Wages of persons while disabled, medical attendance and funeral expenses; also wages of claim agent and others connected with the claim department. Lawyers' fees and other court expenses are not chargeable to this account; nor are damages to property belonging to the company.

26. Contingent Expense.—This account includes the miscellaneous expenses not otherwise provided for; traveling and other expenses of general officers and assistants, etc., etc.

27. Park Properties.—Includes all running expenses of parks owned or leased by the company.

TRANSPORTATION EXPENSES.

28. Car Service.—This account includes the wages of conductors, motormen, starters, aids, inspectors and switchmen; cost of punches, ticket registers, sign sticks, switch sticks and miscellaneous supplies for car service. The wages of the superintendent of time tables and chief of conductors, with such clerks as may be under them, should also be charged to this account.

29. Car House Expense.—This account includes the wages of shed foremen, shifters, cleaners, oilers, wipers, laborers, inspectors and watchmen, except such as are employed on repairs of cars. The cost of fuel, and lighting the car houses and sheds, lanterns and oil for watchmen, tools used by workmen on cars.

30. Lubrication and Waste for Cars.—Oil, grease, tallow and other lubricants, with waste used upon car journals and motors, are included in this account.

31. Supplies.—This account includes such supplies as are constantly needed for the operation of the electric cars, but cannot be charged to repairs, such as lamps, fuses, carbon brushes, trolley cord, etc.

32. Wrecking.—Wages of those employed in getting derailed cars on the track, and removing obstructions and wrecks; tools used and all other expense incurred on the same account. Expense of getting cars back to the car-house, when broken down on the line, is also chargeable to this account.

33. Operation of Power-Houses.—This account includes wages of engineers, firemen, coal shovelers, dynamo men, oilers, cleaners and others employed in the power-houses, except when employed upon repairs. Also the cost of water, water rates, or cost of pumping where the company furnishes its own water works; carbon brushes, fuses, lamps and other supplies necessary for the daily operation of the power-houses, and not otherwise provided for; cost of heating and lighting power-houses. Repairs and renewals of engines, boilers, dynamos, switch-boards and station fixtures are not chargeable to this account. Fuel and lubricants are also chargeable to separate accounts.

34. Fuel.—This account includes the cost of all fuel used in the power-houses, with transportation charges on the same.

35. Lubricants and Waste for Power-Houses.—Oils, greases, tallow and waste for use in the power-houses, for engines, shafting, dynamos, pumps, etc.

36. Water.—Cost of water when taken from local water-works companies.

37. Hired Power.—Cost of power when taken from other electric companies.

MAINTENANCE OF WAY AND BUILDINGS.

38. Repairs of Roadway and Track.—This account includes all expenditures on account of the roadbed and track, except the cost of rails and ties used, and the cost of repairs and renewals of paving, and the supplementary wire. It includes tracks laid in buildings, yards, on turntables, wharves and over bridges; wages of road masters, track foremen, laborers, watchmen and others, while engaged in track repairs and renewals. It includes cleaning, oiling and sanding track, repairs and renewals of drains under the track, repairs and renewals of planking over bridges, repairs and renewals of frogs and switches, joint fastenings, etc., etc. It also includes repairs of rails, and all work on rails, cutting and drilling, except drilling for tie wires. Also labor expended in taking up track. The cost of tools, implements and all supplies used in connection with the track are included in this account, The expense of removing snow and ice, with the cost of repairs on snow plows and sweepers, may be made a separate account if so desired, but comes under the head of Maintenance of Way.

40. Renewals of Rails.—This account includes the cost of new rails laid in the track, with the transportation charges on the same, less the value of old rails taken up. The expense of loading, unloading, drilling, cutting, laying and repairing rails is not included in this account.

41. Renewals of Ties.—This account includes the cost of new ties laid in the track and the freight on the same. The expense of loading, unloading and laying ties is not included in this account.

42. Repairs and Renewals of Paving.—This account embraces all expenditures on account of the paving. It includes the cost of paving blocks and sand, and the cost of transportation of the same; the wages of pavers, laborers and others, engaged in repairs and renewals of paving; also the cost of tools and other supplies for the same work. The expense of taking up and relaying paving, when necessitated by the repairs on the roadbed, the track and the supplementary wire is not chargeable to this account, but to the account for which expense was incurred.

43. Repairs and Renewals of the Supplementary Wires.—This account includes all expenditures on account of the supplementary wire and its connections. It includes the cost of the wire, tie connections, channel pins, solder, and other supplies also tools, and implements used in connection with the work of repairing the supplementary wires; wages of solderers, laborers and others, engaged upon this work. The expense of drilling rails for channel pins and tie wire rivets, is also chargeable to this account. Expense on the supplementary wires, necessitated by the taking up of rails, ties, switches, frogs, etc., are not chargeable to this account, but to repairs of roadway and track. Expense on the supplementary wires necessitated by the taking up or laying of paving should be charged to the account of paving.

44. Repairs and Renewals of Buildings, Docks and Wharves.—This account includes the cost of repairs and renewals of all buildings, docks and wharves, and of the stationary fixtures and furniture of the same, not otherwise provided for; car-houses and sheds, store-houses, car-shops, repair-shops, blacksmith and machine-shops, power houses, coal sheds and bins, stations, etc., etc. Repairs of pits in car-houses and shops, cranes in power-houses and coal sheds, etc., are embraced in this account. Repairs of tracks in buildings and on wharves, are not chargeable to this account.

45. Repairs and Renewals of Poles and Overhead Lines.—The account includes the cost of repairs and renewals of poles and brackets, with trolley, span, guard and feed wires, with all appliances for suspension and insulation of the same.

MAINTENANCE OF EQUIPMENT.

46. Repair of Cars.— This account includes the cost of all repairs on car bodies, painting, varnishing, upholstering, re-lettering cars and car signs; repairs and renewals of the trucks, brakes, brake shoes, axle boxes, springs, track brushes, snow scrapers, pilots, sand boxes, etc.; repairs and renewals of wheels and axles. The cost of new cars taking the place of old to make the number good, are also chargeable to this account. On roads using both motor and tow cars it is sometimes advisable to keep each kind separately.

47. Repairs of Electrical Equipment.— This includes the repairs of motors, their parts and connections, the labor of removing damaged parts and replacing same when repaired. Armatures, fields, gears, pinions, controllers, switches, trolleys, lightning arresters, brush holders, cables, etc., all come under this head. New motors or parts purchased or made and put in to replace those damaged or worn out must be charged to this account also.

49. Repairs of Steam Plant.—To this account should be charged also repairs and renewals of the steam plant in the power-house, including the boilers, engines, pumps and shafting, repairs and renewals of belts, piping, steam fitting, etc.

50. Repairs of Electrical Plant.—Repairs and renewals of dynamos and their parts; armatures, fields, pulleys, commutators, oilers, bearings and boxes, brush holders, etc., are chargeable to this account; also labor removing and replacing damaged parts. Repairs and renewals of the switchboard equipment are also charged to this account, such as repairs and renewals of station switches, rheostats, circuit breakers, ammeters, wiring and connections.

51. Tools and Machinery.—Repairs and renewals of tools and machinery, shafting, boilers, engines, etc., in the shops of the company; also cost of lubricants for the same. Small tools (not shop fixtures) are chargeable to the account most benefited by them.

52. Miscellaneous Expense.—To this account should be charged all miscellaneous expense of maintenance and equipment, not otherwise provided for.

The Use of the Booster on Electric Railway Circuits.

Messrs. J. H. Vail and S. H. Wynkoop in a paper read at the Atlanta Convention on "The Use of the Booster on Electric Railway Circuits" advocate the use of Mr. W. S. Barstow's system of maintaining a constant voltage in a multiple electric circuit, consisting in the employment of an auxiliary apparatus called a "booster." They state that owing to the drop of potential on street railway lines the commercial efficiency of the street railway motor, which is normally about 78 per cent. becomes much reduced, at two-thirds normal being only 52 per cent. With direct feeding the loss in transmitting energy is overcome only by incurring the heavy cost of copper as a first investment. With the booster system, the loss in transmission is overcome by incurring the cost of operation of a machine which shall automatically raise the initial voltage above that of the bus bars by an amount which may exactly equal the drop in potential on the feeder at that instant. When using this machine, the feeder is calculated for ampere capacity only, and the pressure constantly maintained at the service end of the feeder equal to the pressure at the bus bars, irrespective of the length of the feeder or location of the load.

In any instance, the cost of a direct feeder increases as the square of the distance, while the cost of the booster feeder is stated to be directly proportional to the number of miles. The authors state that these characteristics of the latter system result in a reduction in first cost of from 25 to 75 per cent. as compared with the first cost of the ordinary direct feeding methods of present practice; and it thereby becomes possible for numerous electric street-railway companies to extend their lines into suburban localities from ten to twenty miles distant from the power station, at the same time retaining the investment within reasonable limits.

The following equations are given by the authors to enable the two systems to be compared:

Let:

C_1 = Current delivered to trolley wire.
V = Voltage at generator.
V_1 = Voltage at trolley wire.
V_2 = Voltage of booster.
f_1 = Efficiency of generating apparatus.
f_2 = Efficiency of booster.
K_1 = Operating expenses for direct feeding—coal, oil, water, waste, engineers, firemen, and interest on so much of the steam generating and transmission plant as is due to the feeder under consideration.
K_2 = Operating expenses for booster feeding—details as before.
L = Length of feeder in miles.
l = Circular mils of feeder.
A = Initial cost of as much of the steam, generating and transmission plant as is due to the feeder under consideration.
a = Per cent. interest on investment.
d = Per cent depreciation on investment.
S = Cost of steam plant per hp.
G = Cost of generating plant per kw.
B = Cost of booster per kw output.
W = Cost of insulated wire per lb.
R = Cost of placing 5,544 ft. No. 4-0 wire, including insulators, pins, cross-arms, sundry hardware and labor; 5 per cent. allowance for sag.
P = Cost of supplying one hp per year, in quantities of over 100 hp.

Then for direct feeding:

$$A = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746}}{f_1} S + \left\{ \frac{C_1 V_1}{1,000} + \frac{C_1 (V - V_1)}{1,000} \right\} G + \frac{2,315.488\ L^2 C_1}{V - V_1} W + \frac{.5664\ L^2 C_1}{V - V_1} R \qquad (1.)$$

And for booster feeding,

$$A = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746} + \frac{C_1 V_2}{746\ f_2}}{f_1} S + \left\{ \frac{C_1 V_1}{1,000} + \frac{C_1 (V - V_1)}{1,000} + \frac{C_1 V_2}{1,000\ f_2} \right\} G + \frac{C_1 V_2}{1,000} B + .019318\ l\ L\ W + \frac{l\ L}{211,600} R \qquad (2.)$$

Substituting the following values in (1),

$C_1 = 200$	$G = 25$
$V_1 = 500$	$W = 00.13$
$V = 550$	$R = 75$
$S = 45$	$B = 50$
$f_1 = 00.95$	

We have

$$A = 9,755 + 1,374\ L^2 \qquad (3.)$$

Substituting the same values in (2), assuming 211,600 as the value of l, taking $f_2 = .90$, and finding an expression for V_2 in terms of L, we get:

$$A = 8,723 + 2,857\ L \qquad (4.)$$

In order to graphically represent the relation between initial investments in the two methods of feeding under discussion, (1) and (2) have been solved for varying values of L from 1 to 30, and the results plotted on Fig. 1. An inspection on this diagram shows at once the superiority of the booster system over direct feeding in cases where first cost is the essential feature. It will be noted that the curves have been carried out for the entire thirty miles without regard to the practical voltage limit in direct-current machines, or the point at which the cost of operating an independent station becomes less than operating from the main station. Fig. 1 shows that for distances greater than one and one-half miles it will cost less to install a booster system than to place copper and machinery in the usual manner for feeding direct. In cases where the motive power is water, costing little or nothing per hp, these curves give at once the relative economy of the two methods; but ordinarily, on account of the consumption of coal, the loss in the line (represented in the new method by the power required to operate the booster) becomes an important factor in the discussion; and it is necessary to establish equations for the operating expenses, taking into account the fixed charges of interest and depreciation

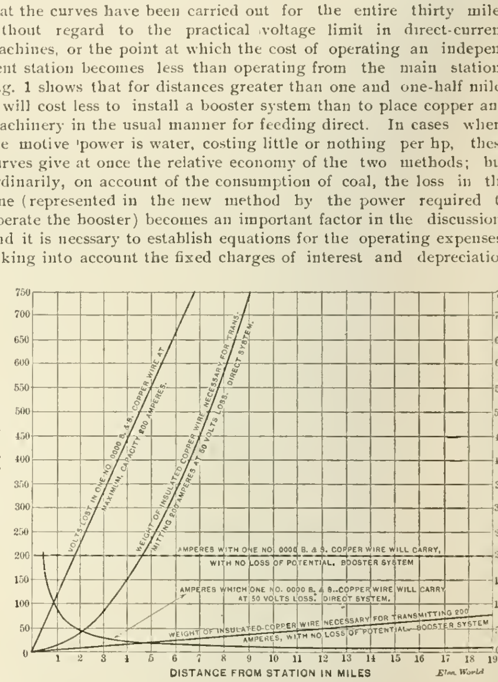


Fig. 3.—Comparison Between Direct and Booster Feeding for Street Railways.

on the investment, as well as the cost of furnishing the required power.

The following equations will enable these values to be determined for different distances:

Direct feeding:

$$K_1 = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746}}{f_1} P + A\ (a + d) \qquad (5.)$$

Booster feeding:

$$K_2 = \frac{\frac{C_1 V_1}{746} + \frac{C_1 (V - V_1)}{746} + \frac{C_1 V_2}{746\ f_2}}{f_1} P + A\ (a + d) \qquad (6.)$$

Making the same substitutions in (5) and (6) as were made in (1) and (2), placing $(a + d) = .10$, and remembering that A varies according to the method and distance under discussion, we get:

$$K_1 = 155\ P + \frac{A}{10} \qquad (7.)$$

$$K_2 = (139 + 36\ L)\ P + \frac{A}{10} \qquad (8.)$$

Fig. 2 represents these equations plotted for varying values of L, P being taken at 40. The intersection of the upper curve with the upper straight line is the point at which the booster system costs as much to operate as does the direct system. This distance we find to be twelve and one-half miles. For shorter distances, direct feeding is more economical, while for longer distances the booster system has an absolute advantage. Now the assumption, upon which (5) and (6) were solved, is a feeder constantly loaded to its maximum capacity. The absurdity of this assumption is apparent when one

considers the actual conditions which obtain in railway work; the average load on the feeder during the entire year will be more nearly one-third or one-quarter of the maximum. Equations have, therefore, been established and plotted similar to (5) and (6), for three-quarters, one-half and one-quarter load, and the resultant curves are shown on Fig. 2, in order to afford ready means of comparison.

All calculations have been based upon the most recent methods of rail bonding and track feeding; and the assumption that the resistance of the return circuit is equal to that of the outgoing circuit is therefore perfectly safe.

While the method outlined may seem like robbing Peter to pay Paul, it must be remembered that in direct feeding there is a large amount of capital invested in the pole line, accruing interest day and night, and irrespective of the traffic on the line; while with booster feeding, the interest on copper investment is nominal, and the power required to drive the booster itself is proportional to the load on the line. Thus it can be understood why, under the conditions given, with an average load of one-quarter the maximum, the booster system is more economical than the direct feeding system for distances over four and one-half miles.

It may occur to some that the installation of a special high voltage generator to supply the feeder in question would be a simpler method of reducing the copper; but a consideration of the enormous variations in drop under extreme changes in load on a long feeder calculated for ampere capacity only, leads at once to the discarding

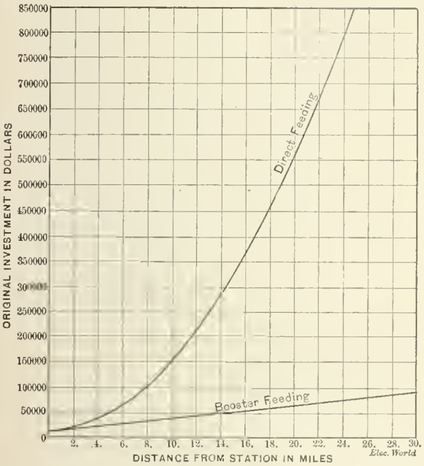


FIG. 1.—INITIAL COST OF STEAM AND GENERATING PLANT, COPPER AND SPECIAL APPARATUS FOR DELIVERING 200 AMPERES AT 500 VOLTS.

of such a scheme until such time as manufacturers can furnish efficient generators over compounded from 50 to 150 per cent.

Fig. 3 gives a specific comparison between direct and booster feeding, showing the investment saved in copper by the latter. The resistance of the return rail circuit is considered the same as the resistance of the feeder; the allowance for weight of insulation is .15 and for sag .05.

Ordinarily in calculating copper for distribution, special features influencing traffic are obliged to be allowed for, such as ball grounds, race tracks, picnic groves, etc. As there is seldom any necessity for bunching cars at all these points simultaneously, and as the various features are usually scattered, it follows that at all times one or more of the feeders is lying comparatively idle. Under the plan suggested, the copper is figured for average conditions, and a booster, placed in the station, is arranged to be thrown immediately upon any feeder which may become burdened with an excessive load.

Another feature of this system entailing economy becomes prominent on long suburban lines forced to run an infrequent schedule late at night. On such a road the booster may be shut down and cut out of circuit entirely when the load on the long distance feeder drops to say one-quarter of the maximum, depending upon the amount of copper in the line. If this suburban line extends to a park or pavilion which is open only during the summer months, the advantage of the booster over direct feeding is great, since the investment on a booster lying idle is a small fractional part of the interest on the idle copper of a direct feeder.

In the progress of electric railways, as in the growth of cities, development frequently fails to follow the lines predicted for it. It therefore happens that many a road to-day is worrying along, the victim of misplaced judgment—and copper. In many instances the adoption of a booster, and a re-distribution of the present copper, will remedy the evil in the most economical manner. In large cities such as Boston, Brooklyn and Philadelphia the purchase of tons of copper could in this way be obviated with a gain at the same time in uniformity of pressure.

Transfers on Street Railways.

Mr. J. N. Beckley in his report to the American Street Railway Association at Atlanta advocated the use of a liberal system of transfers. Such a system should not be too complicated by details or hedged in by narrow restrictions. A good system encourages travel and is a source of profit. The tickets should be of liberal size to permit legible type and prevent crowded matter and should be bound in pads of 100, the pad being so exactly arranged that the month, day and even the hour may be cancelled in ten tickets at once. The subject matter ingeniously arranged can and should comprehend all needed rules. A series number, conductor's number

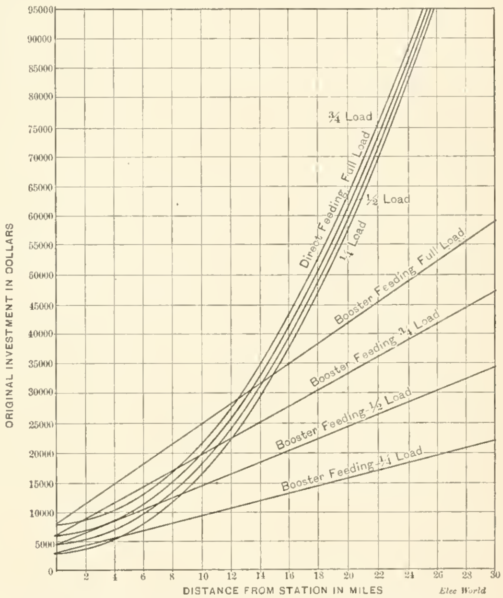


FIG. 2.—EXPENSES OF PLANT DELIVERING 200 AMPERES AT 500 VOLTS, INCLUDING COAL, OIL, WASTE, WATER, LABOR, INTEREST AND DEPRECIATION.

and run of car number, or some such designation of each ticket will identify the issuer perfectly. In the road with which Mr. Beckley is connected there are about 200 conductors; each is given a stack of 25,000 tickets, renewed as used, and these are kept in one transfer department provided with compartments for the purpose. The conductor turns in all unused transfers at the end of his day's work and they are put in his compartment and given out to him again the next day. One double page of a simple record book gives the transaction of each conductor for a whole year. Forenoon and afternoon are distinguished by light and dark print in the distinctions. By the system which this company uses one punch (always preliminary as the conductor keeps these punched ahead in readiness) cancels the month and day, another the time (even hour or ten-minute intervals) and a third the destination.

Reading matter should be arranged so that it can be read as punched all one way, being held by the thumb and finger of the left hand and punched with the left. The ticket should be arranged in every detail so as to be within the mental grasp of the average conductor and to make it easier to do right than wrong.

The consecutive number is not only useful in counting but compels the proper use of the tickets, for if one is used not in direct sequence the number at once tells who issued the ticket. Fraud on the part of the conductor is thus prevented.

Mail, Express and Freight Service on Street Railway Cars.

The report of the committee on this subject was presented at the recent meeting of the American Street Railway Association at Atlanta by Mr. Richard McCulloch. In order to ascertain how much had already been done in this line a circular was sent to every street railway company in North America. From some of the states, notably Pennsylvania, Rhode Island and Massachusetts, it was reported that transportation of express and freight by street railways was prohibited by state law, and many of the roads stated that their franchises allowed only the transportation of passengers.

In regard to the mail service it was found that 62 street railways are now carrying mail, 58 of which have United States Government contracts. Five roads operate special cars for this service.

The only method for handling a large mail service, where it is necessary to collect and distribute along the route, is an independent mail car in charge of a railway clerk. This system is already in use in St. Louis, Brooklyn and several other places. The best example for such service is that on the St. Louis and Suburban Railway. This road begins in the business part of the city and runs through the best residence, and suburban settlements of the town of Florissant, some 16 miles from the centre of the city. The mail car makes three trips each day, two to the end of the line and one as far as the city limits. The railway company furnishes a conductor and motorman while the post-office department supplies the mail clerks. The car is specially built for the purpose. The mail s received from the general post-office in pouches and delivered to arriers along the route, while mail which has come in too late to be sorted is distributed on the cars to the proper bags. In fact the service is practically the same as that on steam railways. A light freight business is also done on the car; provisions, light furniture, milk, trunks, etc., are carried and charges collected by the conductor. The car has proved a source of profit to the railway company.

Where the mere carriage of mail in pouches from the main office to branches or from depots to post-offices is undertaken, and no attempt is made at collection or distribution of mail along the route, there is no objection to carrying pouches on the front platform, if the number is not too great.

The question of whether or not mail service is called for depends entirely upon the local conditions. One of its advantages is that a fixed income can be assured, as the Government contracts generally pay a certain sum per 100 pounds per mile. Another advantage, and one which is of considerable importance, is the prestige of the name of the United States Government. The Government will tolerate no interference with the distribution of mails and this may prove a great advantage in the case of strikes and riots.

In regard to express and freight service 35 roads are now engaged in the express business, while 55 are hauling freight. The distinction, however, between the two classes of service is so ill defined that it is perhaps best to consider both together.

The street railway in many respects is an almost ideal agent for the transportation of packages and light freight, and such a service may well be looked into by street railway managers as a source of profit. As an example of such a road operating express and freight service involving collection and a house to house delivery, the case of the Southern Railway of St. Louis may be stated. The railway begins in the heart of the city and runs a distance of about seven miles through a thickly settled territory. Three trips per day are made on schedule time by the express car. At the down-town end is a receiving station where a clerk receives all the express parcels consigned to the company and keeps the books. The delivery is accomplished by means of wagons, two of which are kept at the down-town end of the road and three meet the cars at certain points along the line. A charge of ten cents per package is made for this delivery and trunks are taken from houses to the Union depot, checked and the checks returned for the sum of 50 cents. A corresponding charge, according to size, is made for the delivery of large boxes or bundles. The large dry goods and clothing houses have ceased to run delivery wagons into this part of the city and now consign all their parcels to the railway company. Several large factories also consign all their freight to these expresses. The railway company assumes all the responsibility of a common carrier.

It may even be advisable to establish an express or freight service as an auxiliary to the passenger trafic, regardless of whether it pays or not; the increased passenger receipts and the advertising given the company may more than counterbalance any loss.

As stated above, the use of a separate car is strongly advocated. A single box car equipped with motors of its own will handle the light freight or express of quite a territory, without interference with the regular running cars. A 25-foot car, equipped with double trucks, supplied with the most approved form of motors and controllers, and fitted up either as a mail car, express car, or a combination of both, may now be obtained for from $2,000 to $2,500, and a smaller car mounted on a single truck can be obtained for less money. If heavy freight is to be hauled it should be carried in trailer cars built especially for the purpose.

One interesting variation of such a service is that soon to be introduced upon the Union Depot Railroad of St. Louis, for which is now being built a hospital car. This is a 25-foot body double truck car, having a double floor filled with asbestos to deaden sound, and fitted with stretchers, apparatus for heating water by electricity, an emergency drug store, instruments and all necessary apparatus for caring for the sick and injured. A surgeon is to be in charge of the car.

The discussion of the whole question may be briefly summed up in the following conclusions:

1. That a mail service involving collection and distribution is best handled on a separate car, operated on the same plan as a United States Railway Mail Car. 2. That it is supposed that a great advantage arising from the transportation of the mails comes from the fact that the road is under the protection of the Government, and is thus secure from riots, strikes and blockades. 3. That the most promising opening for an express or freight service is a road running between two towns, or a city road running through well populated suburbs. 4. That the questiou whether or not such a service will pay is entirely a local question, and must be estimated for each road separately, under existing conditions. 5. That there are cases when it would be advisable to operate such a service, independent of the profits, in order to accommodate the patrons of the road and to induce building along the line or the road. 6. That such a service operated upon the ordinary street railway must not be allowed to interfere in the least with the passenger traffic. 7. That in States having laws prohibiting this service, associations of railway managers should be formed to secure favorable legislation.

Brake Shoes.

In a paper under the above caption read at the Atlanta Convention, Messrs. D. F. Henry and Powell Evans advocate the adoption of a standard brake shoe, and discuss the question of material for the same.

It is stated that in round numbers there are on all lines of street railways in the United States, 50,000 cars, including steam and eletric motors, cable grip cars, trail and horse cars. Assuming an average mileage of 75 miles per day for all cars, including an allowance made for cars used in rush hours only, and others under repair, the total result would be 3,750,000 car miles per day. Taking the average life of brake shoes at 5,000 car miles, and an average of 5 shoes per car, there is a daily consumption of 3,750 brake shoes, and an annual consumption of 1,368,750 shoes. At an average weight of 21 pounds each, new, the total weight is 28,743,750 pounds; at 2 cents per pound, amounting to $574,875. Deducting from these amounts an average weight, per shoe, of 9 pounds when worn out, there are 12,318,750 pounds of scrap, at 1-3 cent per pound, equal to $41,062, leaving a net balance of $533,813. This represents what is paid annually for metal actually ground to dust braking cars. To this must be added the cost of labor in changing the shoes. Allowing 30 minutes per shoe for replacement and adjustment of rods, etc., and $2 per ten hours' day for labor, this total annual charge would be $136,875. Adding this last figure to the net cost of metal, gives the total annual charge of $670,688 for brake shoes, equal to about $13.70 per average car.

The Master Car Builders' standard brake shoe is strongly advocated; it weighs less than any combined shoe and hanger, and most of the metal in it is available for actual wear—leaving the smallest possible percentage of residue for the scrap pile. This standard further requires but one pattern for right and left shoes for all trucks, and car-house men thus become more quickly familiar with it and accustomed to its fitting.

No conclusion is reached by the writers as to material. They state that there are three main conditions involved—that it should be economical in wear itself, economical as regards wear on wheels and should have a good co-efficient of friction. It seems to be generally conceded that neither chilled iron nor steel is advisable, as they have not a sufficiently firm hold on the wheels and wear them too much. Soft cast-iron, on the other hand, is satisfactory on both these points, but wears out too fast. Various combinations of soft and medium hard cast-iron, with wrought iron, chilled iron or wooden segments inserted in the frictional face—from 20 per cent. to 40 per cent. of the face—have given the best results in all these respects in street railway service so far.

City and Suburban Electric Railways.

The report on this subject, presented at the Atlanta meeting of the American Street Railway Association by Mr. E. C. Foster, considers the subject at some length. Mr. Foster expressed the view, in regard to the projection of a road, that it should at least be capable of earning its operating expenses from the start, and that there are very few cases in which companies are warranted in investing money in a line on the strength of the future alone. Competing lines should be avoided except where there is sufficient business to support both, or when it is necessary to keep out competition. In regard to track construction, the kind most desirable for a certain location depends entirely upon local conditions. It is now often possible to obtain an independent right of way for a very slight cost, sometimes for nothing, and this offers advantages over the use of the public highway. For such a right of way the regular steam road form of construction would be employed. About a 60-pound T-rail, 6x7 inch oak or chestnut ties, laid two feet centres, needle switches with lever throw, etc., would give a track that would allow a speed of 40 miles an hour, making it necessary only to lessen speed for curves and as much for switches as the overhead construction demanded. Where it is decided to build on country roads, a location at the side of the road is desirable. Here a T-rail may be laid and the track filled with gravel, covering the ties and leaving the heads of the rails entirely exposed. In the streets of small towns where permission can be obtained, it is also desirable to lay a T-rail, although there is always more or less trouble in maintaining the paved brow which is usually required. In city streets and others that are paved the girder rail seems to be the only one suitable. This should be nine inches deep and weigh about 90 pounds per yard. This makes a very expensive construction. While such a construction is necessary where the track is laid in streets paved from curb to curb, it is a question as to what is best in a macadam street The frequency of the service is an important factor in determining the most economical construction, and a nine-inch girder rail ceases to be a necessity when the number of cars run over it daily is reduced below a certain figure. Such a rail becomes covered with dirt and the cars rattle worse in running over it than in running on a dirty rail of less rigidity. It is worth while at least to consider for certain places the relaying of a good tram rail, using some approved form of joint plate.

In regard to overhead construction, little trouble is experienced in modern lines. Regarding equipment, the longest car that can be operated successfully on four wheels is the most desirable for ordinary conditions. For long distance lines having heavy traffic 30-foot car bodies on double trucks, for box cars, and bench open bodies on similar trucks, are recommended. Where there is sufficient demand a combination smoking and baggage car should be run as the trailer car on a train of two.

In building a new road for short distance travel, all curves should be given the necessary raidii for the use of 7-foot wheel bases, and trucks should be of this standard. On these trucks should be used 20-foot box car and 10-bench open cars, either class measuring about 29 feet 6 inches over the buffers. As a supplement to the regular cars, trailer cars are recommended, and that they may run economically a power-brake is necessary. To meet this demand an air-brake is being developed. For convenience in attaching motors to trailer cars automatic couplers are necessary, and there are several forms of latch couplings that work satisfactorily. For the use of trailers it is essential, of course, that all buffers and draw bars be of one height.

In regard to the electrical equipment, it goes without saying that the modern multipolar single reduction motors with series parallel controllers are the only ones that a road can afford to use.

It is desirable to heat all cars in the North as it has an important effect on the receipts. Electric heaters can hardly be depended upon. It is found from experience that it takes from 8 to 12 amperes to keep a 20-foot car comfortable; that is 40 degrees above the outside temperature. This would make 72 car miles of power per day of 18 hours chargeable against the heaters. When it is considered that this extra power is often demanded when the power is needed for other purposes, it may be seen that outside of the cost of coal the consideration of the increased capacity of the power station and feeder system is an important one. Unfortunately the stove is about the only thing to fall back upon, although for short trips from the car house a hot water storage system might be used.

It is probable that before long a telephone system will be considered a necessary part of each car operated on suburban lines. As a substitute for this arrangement, or in connection, with it a system of signals between turn-outs may be desirable, but this adds complications and is likely to encourage carelessness on the part of the men.

The adoption of a proper schedule of fares and transfers is a most important matter. Where the routes are too long for a single fare it is best to divide the line into sections, collecting a fare in each and registering all as the standard fares. The chief difficulty here will be in deciding the limits of the sections. The selections of the best rates of fare is an important subject and must depend upon local conditions. One and one-fourth cents per mile is perhaps a minimum rate for the basis of a system of fares, no fares to be less than five cents, and the establishment of higher rates up to two cents per mile may be recommended under certain conditions. In some cases it may be advisable to issue round trip tickets; transfers may be used within reasonable distances but the system should be carefully worked out to avoid the possibility of its abuse.

Suburban roads work at a disadvantage compared with city roads when the question of operating expenses is considered. In the city a much larger number of cars can be cared for in one car-house. A small car-house, also, cannot afford the motor tables, traveling cranes, etc., which lessen the cost of motor and truck repairs. The work can also be divided up in a large car-house so that the men can work with greater economy. The cost of power on suburban roads is often considerably higher, as they are usually dependent on a number of small stations. In regard to the elimination of the difference in power cost which now exists in favor of city roads, the indications are that the time is coming when by the introduction of the alternating current system it will be no longer necessary for the country road to maintain its numerous steam plants. In such a system there could be one main power station while in various selected places rotary transformers could be placed, one for each section of the road. These rotary transformers would require only the same care as generators, the only apparatus in the sub-station needing attention being the circuit breakers. The sub-station could often be in a car-house, thus reducing the cost of construction and labor. It is stated that with such a system using 6,000-volt three-phased currents from a station located in a central point, the power could be supplied by using No. O, B. & S. wire to a road 50 miles in length with 50 cars in operation, with a total efficiency, neglecting the loss in the trolley wires, of about 65 per cent. To accomplish the same result with the present system of 500 volts there would be required 600 No. O. B. & S. wires. Perhaps the most important difficulty of such a system would be the insulation of the line. The public is prejudiced against the use of bare wires and it might be wiser to cover the wires merely to save comment. It would be absolutely necessary to keep the wire off trees as the superintendent of the Hartford Electric Light Company states that a twig short circuits their 5,700 volt main almost as readily as a wire.

The Street Railways of Atlanta.

The following matter was inadvertently omitted from the article in our last issue under the above caption, and refers, except the last paragraph, to the Collins Park & Belt Railway:

The operating expenses average between $35 and $40 per day, and are divided as follows:

Motormen and conductors	$12.00
Superintendent and management	3.33
Other labor	12.33
Oil	1.00
Coal	7.00
Repairs	4.00

Motormen and conductors receive $1.50 per day, their average number of hours of work being 13. Trackmen and firemen get $1.00 per day each, armature winder $2.00 per day, car inspector $1.25 per day, chief engineer $2.25 per day, and night engineer $1.50 per day. The road does a good business in summer, but loses money in winter. At the present rate the road is earning about 6 per cent. on $50,000, or one-fifth of its cost. The road will continue to be operated by the receiver, Mr. Darr, until the times improve and the road can be sold.

The total investment in street railways in Atlanta is between four and a half and five million dollars. The three roads average very nearly 8,000 car miles per day and carry over 23,000 passengers daily.

Expensive Fishing.

An Englishman named Hill, has devised an elaborate, automatic, electric system for catching fish, the cost of the current for which is at least $2.62 per fish. He did not patent the system.

Notes on the Management of Railway Power Stations—IV.

BY GEORGE T. HANCHETT.

POWER CONNECTIONS.

The power connections of a station, like the steam fitting, so often have to be added to and repaired that a few notes on them will be considered.

The rule for the calculation of pulleys is well known, but is readily remembered if given as follows:

$$\overbrace{\text{Diameter} \times \text{speed}}^{\text{Pulley No. 1.}} = \overbrace{\text{diameter} \times \text{speed.}}^{\text{Pulley No. 2.}}$$

Thus, if we have three of the above quantities given we multiply together the two pertaining to any one pulley, and dividing by the remaining quantity we find the desired quantity, diameter or speed as the case may be. There is about 2 per cent. slip in good belt transmission, therefore, make the driver two per cent. larger than given by this rule, or the driven two per cent. smaller. The face of a pulley should be five per cent. wider than the belt it carries, and should be crowned .1 of an inch for every foot of width. The width of a belt is often computed solely from the tensile strength, the stress it has to bear, factors of safety, etc. This method is as fallacious as to figure the area of a wooden tension member by its tensile strength.

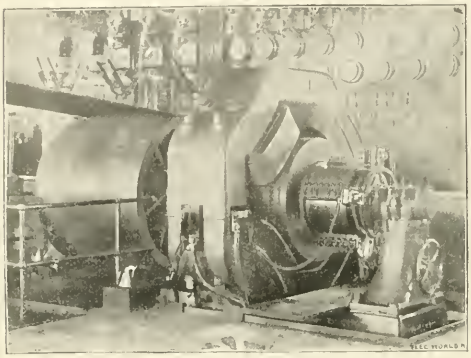


Fig. 13.—Belted Power House Generator.

The width of belting should be governed by the adhesion to the pulley, the distance between centres and other data as well as the tension existing, and if all of these are carefully considered the resulting tension per inch of width will be as far below the tensile strength of the belt as the current of a carefully figured incandescent wire is below its carrying capacity. However, rules are given by competent authorities which depend on tension and not on adhesion. These are very convenient, and usually give safe values. The writer cannot see any proof for such formulae and would consider them as empirical rather than rational. The following are very good for general work:

$$\text{For single belts, } W = \frac{\text{hp} \times 3{,}000}{D \times R}$$

$$\text{For double belts, } W = \frac{\text{hp} \times 2{,}000}{D \times R}$$

where hp = horse-power transmitted.
W = width desired.
D = diameter of pulley in inches.
R = revolutions per minute.

This assumes that the belts are open, the arc of contact is a semicircumference and that the pulleys are of equal diameter, and at least ten times their diameter between centres. If the case departs from this the width should be varied accordingly.

The formulæ given are modifications of existing formulæ. The writer on figuring a belt by the formulæ of four different authorities obtained results varying from 25 to 35.2 inches, and he ventures on his own authority to give the constants an average value, which will be found very convenient in figuring, and in his opinion sufficient for formulæ deduced on such principles, and upon which good authorities differ so widely. Such a general rule as this must be used very carefully. Cases where the belt costs $500 or more should be carefully specialized as money will be saved thereby.

In general, high speed belts need not be as wide as low speed belts transmitting the same pull. Double belts will not transmit twice as much power as single belts; their widths are in the ratio of about 2 to 3; they are strong enough to transmit twice the power but their area of contact is not proportional to their strength. General formulæ should be used on small belts *only*.

Belts should be tight enough to prevent slipping and flapping and *no tighter*. Belts that are too tight often absorb five to ten per cent. more of the energy transmitted than they should, beside being short lived. They shorten the lives of the bearings and greatly increase the chances of hot boxes. This is an evil which very often is prevalent in power stations. To avoid the necessity of tight belts never run with the tight side on top and never run belts at an angle from the horizontal greater than 45 degrees. Belts should be frequently softened with some reliable belt dressing. Never use a belt dressing that contains an animal oil. When you have carefully calculated and checked from reliable data the proper size of a large belt for a dynamo do not be afraid of your result. A small armature will absorb an immense amount of power. Fig. 13 shows a good example of such a case, where the armature seems very small in proportion to the pulley and yet the machine is in operation in a well designed station.

The running of a belt may sometimes be improved by changing it end for end. Never turn it inside out. Belt speeds of greater than 5,000 feet per minute are not advisable. The hair or grain side of the belt should run next the pulley. Never "run" a belt on to a pulley of a dynamo. Slacken off the tension screws and put it on and thus save straining one side of the belt. Short belts require to be tighter than long ones. The weight of a long belt materially increases its gripping power. Covering a pulley with leather permits a much slacker belt and saves power. It accomplishes the same result as perforating the belt, which is a most expensive way of getting better adhesion, and one of doubtful value. The adhesion is doubtless better, but the life and strength of the belt is seriously impaired.

It is said that there is a chemical action between the tannic acid of the belt and the iron of the pulley, which cuts the former. Leather covering would avoid this also. The static charges which accumulate on rapidly moving belts should be conducted away by combs made of sharp metal points and connected electrically with the engine bed. The shock from a static discharge of a belt, while never dangerous in itself, is extremely disagreeable and is liable to cause a man to lose his balance and fall in a dangerous place. The station engineer has enough chances of getting shocks without this added one.

For figuring the horse-power of a shaft the writer suggests the following formula, which will be found convenient, accurate and easy to remember:

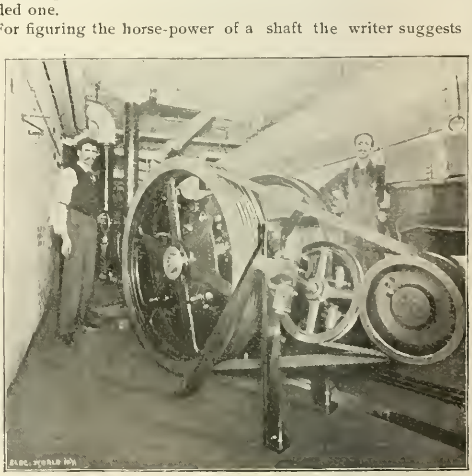


Fig. 14.—Example of Rope Transmission.

$$\text{hp} = \frac{r^3\, n}{16},$$

where r = the radius of the shaft, n = the number of revolutions per minute, hp = the horse power the shaft is capable of transmitting. This applies to turned iron shafting well supported by bearings, and is suited for jack shafts.

The following table, calculated from the above formula will prove

useful. To use it multiply the number in column B, by the speed of the shaft and obtain the horse-power it will transmit. It is easy to see that B is the horse-power transmitted at one revolution per minute.

Dia.	B.	Dia.	B.	Dia.	B.	Dia.	B.
1	.0078	2½	.1207	4	.5000	5½	1.299
1¼	.0192	2¾	.1625	4¼	.6437	5¾	1.485
1½	.0264	3	.2109	4½	.7119	6	1.687
1¾	.0419	3¼	.2937	4¾	.8376	6¼	1.907
2	.0625	3½	.3349	5	.9766	6½	2.145
2¼	.0889	3¾	.4119	5¼	1.131	6¾	2.402

Hot boxes on a jack shaft are more serious than on a single machine as they may disable the whole plant. It is well for this reason to have the jack shaft in sections. The boxes of shafting usually have compartments, which should be filled with heavy grease, that will melt if the box gets abnormally hot and thus lubricate it. A hot box on a jack shaft should be treated as explained in the last article, and, in addition, the load thrown off adjacent belts, if possible. If the shaft can stand the transverse strain without injury, withdraw the supporting screws from the hanger and allow the box to turn with the shaft. This is liable to "freeze" the box fast to the shaft, but it will save a shut down. It is usually necessary to push the box along the shaft to accomplish this.

Friction clutches when well made are very useful adjuncts. Their liberal use on the jack shaft will make the plant very flexible. A poor friction clutch is worse than none and will continually give trouble. In repairing or adjusting friction clutches be careful not to leave tools on the inside of the pulleys. On starting up they are usually thrown with considerable violence, or they may possibly remain in the pulley, and be thrown out at the end of the run. The writer witnessed a case where a monkey wrench had been traveling with the rim of a pulley for six or seven hours, and on shutting down his engine the engineer came uncomfortably near receiving the wrench on the head as it was hurled from the pulley.

In replacing a box on the jack shaft great care must be taken not to spring the shaft by the supporting screws. They should be screwed into their sockets by hand, and then set up alternately and finally locked. Newly babbited bearings or burned or scored bearings may be scraped to a surface by a half round file with all the teeth ground off, leaving only sharp edges. A mixture of stove blacking and cylinder oil may be rubbed on the shaft, and by occasionally applying the halves of the box to the shaft thus treated and scraping down the blackened portions, a smooth running surface may be rapidly attained. Babbited bearings can usually be repoured in place on the jack shaft. In such a case be careful to have the shaft free from oil or any foreign substance that would cause trouble by bubbles. Stop the ends and other places by frayed manilla rope strands well served with moist clay. The lower half should be poured first. This may be done from the side. Then the upper half may be bolted on and poured through the oil holes. Unbolt and separate the two halves of the box, and drill out the oil holes and cut off the snags. It may be necessary to flute some oil grooves. When scraped the box is then ready for use.

Direct connection is the ideal method to power connection. The obstacles of high speed of generators and low speed of massive engines have been so reduced that this is possible. It is more expensive than belt driving, but it is in every way more satisfactory. It economizes floor space, not, only by its small compass, but by the positions in which a set may be placed irrespective of other machines.

The rope transmission shown in Fig. 14 may often be used to great advantage. It, however, absorbs a great deal of power, and the pulleys get quite warm and the life of the rope is short. The chief attraction of the system is the economy of floor space.

In the case of Fig. 14 the engine speed is 320 revolutions per minute. The diameter of the drive pulley is 54″ the distance between centres 60″. The dynamo pulley has a diameter of 14′ and the idler is exceptionally large, being 18″ in diameter. The drive rope is ¾″. This is reputed to be the shortest rope transmission in the country.

The figure looks somewhat distorted, as it was a matter of extreme difficulty to photograph the drive. The lens was very wide angled, so much so that it was impossible for the operator to get out of its range. The camera stood in a little alcove not more than eight feet away.

Railway units are subjected to more severe changes of load than any other source of electric power. The whole system should be exceptionally rugged.

(To be continued.)

Electric Railways in Germany.

(From our own Correspondent.)

Great activity prevails in the preparation of projects for electric railways intended to furnish means of rapid transit throughout Berlin. The existing elevated road, which is worked by steam locomotives, traverses the town, roughly speaking, in a direction east to west, and joins at either end ring shaped loops which encircle the town north and south. The service of trains is frequent, but the running speed is very slow, so that fast running electric roads would be sure of patronage. Under these circumstances it is but natural that large electric manufacturing firms, as well as independent engineers, and even laymen, are busying themselves with the elaboration of railroad schemes, especially as it is hoped to reap a rich harvest in passenger fares when the exhibition, which is planned for 1896, will, it is thought, attract visitors to Berlin from all parts of the Fatherland. Some of the projects are yet in the air, others are so absurd that their realization is impossible, but some are good and will be carried out.

Amongst the latter is one for an elevated electric road from the Warsaw Bridge in the east of the town to the Zoölogical Gardens in the west. This line will run south of, and more or less parallel to, the central part of the existing belt railway, and will facilitate the communication with three of the most important termini of main lines running from Berlin to the south and east. The project has been worked out by Messrs. Siemens & Halske and has already received the sanction of the town authorities. The sanction of the Prussian State has not yet been obtained but is certain, so that active operations are about to begin.

Another electric road had been projected by the Allgemeine Elektricitats Gesellschaft, which was intended to pass through Berlin along a line approximately north and south. This road was to be carried in cast iron tunnels underground in the manner adopted for the City and South London and the Waterloo and City lines, but the town authorities have up to the present declined to give their sanction. It is, however, merely a question of time when this road will also be built, because the want of some means of rapid transit between the north and south of Berlin is very great and an elevated or a level road is inadmissible.

Even the tramway companies are beginning to realize the advantages of electric traction, as evidenced by the fact that the largest of these has for a fortnight had three electric cars running in between the regular horse cars on one of its lines. They are battery cars, supplied by the Allgemeine Elektricitats Gesellschaft, and the undertaking is merely intended as an experiment to show that electric traction, even with accumulators, is commercially feasible.

In addition to the lines just mentioned, Messrs. Siemens & Halske are now building two trolley lines, one in the north and the other in the south of Berlin, but without connection to the centre of the town. Another project which is almost certain to be carried out next year is the change of the present horse car line through the Thier-Garten into an electric trolley line.

In Cologne there has been erected a short experimental track of a suspended railway, the invention of Herr Eugen Lange. The road is formed by a continuous overhang at the side of iron posts, and the cars are suspended from this girder. The suspension is perfectly free, so that on curves the car assumes an inclined position. The inventor claims for this system great rapidity, cheapness, ability to pass sharp curves and an æsthetic appearance. Two members of the Berlin Magistracy have been sent to Cologne to inspect the experimental line and report on the question whether the system is suitable for Berlin.

Within the last few days yet another inventor has submitted to the municipality his plan for rapid transit. This gentleman, Mr. B. Grauel, proposes to lay throughout the town a kind of underground switchback, and aims at attaining on the deepest, and, therefore, horizontal portion of his track, a speed of 75 miles per hour. Passengers would have to change carriages between any two sections.

Ohm's Law.

One of the directors of an electric railway company inquired of one of the electrical engineers of the road the meaning of $C = \frac{E}{R}$, which he saw around so much, and on being told that it stood for Capital $= \frac{\text{Earnings}}{\text{Receipts}}$, he replied that he thought it was a capital joke.

Electrodynamic Machinery—XIII.

BY E. J. HOUSTON AND A. E. KENNELLY.

67. It is evident, since the attractive force exerted across a square centimetre of polar surface is equal to $\frac{\mathcal{B}^2}{8\pi}$ dynes, that doubling the intensity at the polar surface will quadruple the attraction per square centimetre. Therefore, all electromagnets, which are intended to attract or support heavy weights, are designed to have as great a cross-sectional area of polar surface as possible, combined with a high magnetic intensity across these surfaces. If, however, the increase of the area of polar surface is attended by a corresponding diminution of flux density, the total attractive force across the surface will be diminished, because the intensity, per-unit-area, will be reduced in the ratio of the square of the intensity, while the pull will only increase directly with the surface. It is evident, therefore, that soft iron of low reluctivity is especially desirable in powerful electromagnets.

If, for example, cast iron instead of soft Norway iron was employed in the construction of the magnet of Fig. 48, and the same M. M. F., namely, 6,324 gilberts was applied the mean magnetizing force would be this M. M. F., divided by the mean length of the circuit in cms, or

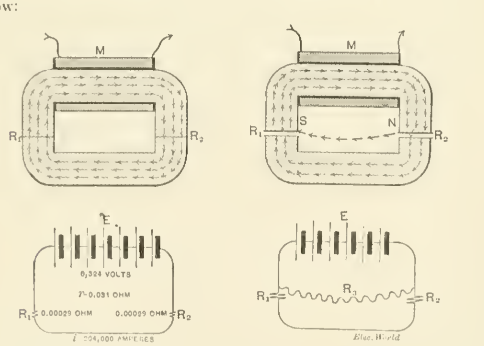
$$\mathcal{H} = \frac{6,324}{50} = 126.48 \text{ gausses.}$$

At this magnetizing force a sample of cast iron would have a reluctivity represented by the formula $\nu = (a + b\mathcal{H})$, where a, may be 0.0027, and b, 0.00009, so that its reluctivity at 133.92 gausses of magnetizing force would be $(0.0027 + 0.00009 \times 126.48) = 0.01407$. The reluctance of the cast iron circuit, including the small reluctance in the air gaps, would be $\frac{50}{12} \times 0.01407 = 0.05863$ oersted, and the flux in the circuit would be $\frac{6,374}{0.05863} = 108,700$ webers, or an intensity of 9,058 gausses. The magnetic attraction between the surfaces per square centimetre would, therefore, be

$$\frac{9,058 \times 9,058}{25.133} = 3,264,000 \text{ dynes, or } 3,331 \text{ grams weight,}$$

or 7.342 lbs. weight, and since the total polar surface amounts to 24 square centimeters, the total attractive force exerted between and across is 176.2 lbs. weight. The effect of introducing cast iron instead of wrought iron into the magnetic circuit, keeping the dimensions and M. M. F. the same, has been to reduce the tota pull from 620.64 lbs. to 176.2 lbs. or 71.6 per cent.

68. If now an air gap be placed in the circuit of half an inch (1.27cm) in width, at R_1, and R_2, as in Fig. 49, two results will follow:



Figs. 48 and 49.—Diagrams Representing a Simple Ferric and an Aero Ferric, Circuit, and their Electric Analogues.

(1.) A greater reluctance will be produced in the circuit.

(2.) A leakage or shunt path will now be formed through the air between the poles N and S. Strictly speaking, there will be some leakage in the preceding case of Fig. 48, but, with a ferric circuit of comparatively short length, it will have been so small as to be practically negligible. In Fig. 49, however, the reluctance of the main circuit between the poles including the air gaps will be so great as to give rise to a considerable difference of magnetic potential between the poles N and S, so that appreciable leakage will occur between these points. The reluctance of the leakage-paths through the air will usually be very complex, and difficult to compute, but, in simple geometrical cases, it may be approximately obtained without great difficulty. In this case we may proceed to determine the magnetic circuit first on the supposition that no leakage exists, and second on the supposition of the existence of a known amount of leakage. Assuming that the cores are of soft Norway iron, and that it is required to establish a total flux of 204,000 webers through the circuit, then the flux density in the iron will be 17 kilogausses and its reluctivity 0.0073. The reluctance of the circuit so far as it is composed of iron, will be 0.03042 oersted, while the reluctance of each air-gap will be $\frac{1.27}{12} \times 1 = 0.1058$ or, in all, 0.2016 oersted. The total reluctance of the circuit will, therefore, be 0.23202 oersted, and the M. M. F. required will be $204,000 \times 0.23202 = 47,330$ gilberts $= 37,660$ ampere-turns, or with 2,000 turns, 18.83 amperes. The attractive force on the armature will be 620 lbs. as in the previous case.

Considering now the effect of leakage, we may assume that the reluctance of the leakage path through the air $\mathcal{R}_3$, is 0.5 oersted, and that a flux of 108 kilowebers has to be produced through the lower core; the length of mean path in the lower core being 20 cms, and in the upper core 30 cms, it is required to find the M. M. F., which will produce this flux through the lower core.

The intensity in the lower core will be $\frac{108,000}{12} = 9,000$ gausses, at which intensity the reluctivity of Norway iron will be, by Fig. 47, 0.0006, so that the reluctance of the lower core will be $\frac{20}{12} \times 0.0006 = 0.001$ oersted, and this added to the reluctance of the two air gaps, 1.27 cms in width, $= 0.2016 + 0.001 = 0.2026$ oersted. The magnetic difference of potential in this branch of the double circuit will, therefore, be $108,000 \times 0.2026 = 21,880$ gilberts. This will also be the difference of magnetic potential between the terminals of the leakage path $\mathcal{R}_3$, and the leakage flux will, therefore, be $\frac{21,880}{0.5} = 43,760$ webers. The total flux in the main circuit through the upper core will be the sum of the flux in the two branches, or $108,000 + 43,760 = 151,760$ webers, making the intensity in the upper core $\frac{151,760}{12} = 12,647$ gausses, at which intensity the reluctivity is 0.00121, so that the reluctance of the upper core is $\frac{30}{12} \times 0.0012 = 0.003$ oersted. The drop of potential in the upper core will, therefore, be $151,760 \times 0.003 = 455$ gilberts, and the total difference of potential in the circuit, or the M. M. F., will be $21,880 + 455 = 22,335$ gilberts $= 17,775$ ampere-turns, or 8.89 amperes at 2,000 turns.

(To be continued).

Municipal Electric Lighting in London.

Hitherto the metropolis has been somewhat backward in adopting the latest thing in municipalization, to wit, electric lighting. Up to the present only one local authority, the St. Pancras Vestry, has undertaken the electric lighting of its own district. Recently, however, two more local authorities have brought themselves up to date. On Monday the electric lighting station belonging to the Hempstead Vestry was formally "inaugurated." This station is admirably situated in an open plot of ground close alongside the track of the London & North Western Railway, and close to its "compulsory area," that is to say, close to the district in which mains *have* to be laid under every street. This district is of triangular shape, and contains as fine a residential quarter as could be well imagined. The system of supply is of 2,000 volts alternating current, with transformers placed in pits under the pavements, with their secondaries feeding into a three-wire network. There are a few street arc lights. These are run off so-called constant potential 1,300 volt dynamos, the current being kept constant by varying the speed of the engine by hand, and by altering the resistance of the field magnet circuit. The other municipal stations which will be opened at once, is that at Ealing, a favored suburban district. Here also the system adopted is that of transformer-sub-stations; the only point of novelty being that the waste heat from the Parish refuse destructors "fume creator," from which gasses issue at a temperature of between 1,200 and 1,800 Fahr. is made use of to heat the boilers during the hours of light load, and the sewage effluent from the Parish sewage station, close at hand, is made use of for condensing purposes. All this sounds extremely economical, but whether, when everything is taken into consideration, any real economy will be effected, time alone will show.

Accidents to Fly Wheels in Power Houses.

To the Editor of The Electrical World:

Sir: In your issue of October 13th you publish a letter from T. C. Coykendall upon fly wheel accidents. This being a subject in which I am somewhat interested, I have kept a rough list of such accidents in the last two years, and find that there have been over thirty, causing a large total damage and a loss of several lives. I have given the matter no real study, but would like to present a few thoughts upon the subject to be considered with Mr. Coykendall's.

There are undoubtedly several causes of fly wheel accidents, the simplest being the case where the wheel goes to pieces from the running away of the engine, due to failure of the governor gear, from original defects or from accident. In the list which I have, I find only one or two accidents in any way chargeable to this cause, or in which there was even a noticable increase of velocity immediately before the accident. Other failures have been charged to "variation in load," but we find that fly wheel accidents are comparatively rare in rolling mills where the variations of load are fully as sudden and severe and always accompanied by much more shock or jar than is ever found in similar cases in electric service. There must evidently be some difference in the conditions, which difference I think will be found in the fact that nearly all the so-called "fly wheels" which have failed either in electric power or manufacturing service, have been used not only as "fly wheels" but as "transmission wheels," the power being taken off the rim by belts or gears.

Now, if we consider roughly the case of a fly wheel acting purely as a fly wheel, with all the power taken off the shaft at some other point, it will be found that when in service the arms of these wheels, when the engine is running under its normal load, will be subjected only to the strain necessary to carry round the rim, with the slight additional work required to pass the engine over the centres. A sudden releasing of load from the engine will tend to let the engine go ahead with the result that the arms have to take the additional strain of holding back the engine to the rim, which continues at practically the same speed. This strain will be in the same direction as the former general strain upon the arms, and will be immediately lessened by the cutting off of the steam by the governor. In the case of a sudden increase of load, the tendency of the wheel will be to go ahead in order to pull the shaft around to meet the increased load, and the admission of the steam by the governor will tend to thrust the engine forward, thus relieving the arms of a large portion of the work thrown upon them by the rim.

Take, now, the case of the fly wheel acting as a transmission wheel with the power taken off at the rim. With the engine running under its normal conditions, the pull upon the rim tends to keep the wheel back, and the tendency is for the steam, through the medium of the piston, connecting rod, crank and shaft, to tear the arms out of the wheel forward. A sudden release of load means that the rim of the wheel is immediately allowed to go forward, thus lessening this tendency, and at the same time the cutting off of the steam by the governor lessens this tendency still more by the slowing down of the shaft.

Take, however, the same engine running light, and suddenly increase the load, we find that the strain upon the arms tending to tear them out forwards is immediately enormously increased by the extra force tending to hold back the rim, while at the same moment the governor, opening to give steam to the engine, gives additional tendency to tear out the arms forward, only limited by the amount of possible total pressure on the area of the piston, with full boiler pressure, and the momentum of piston, connecting rod, etc.

These conditions, it seems to me, would fully account for nearly all these large wheels going under sudden increases of load rather than sudden decreases of load, and would show that either we should abandon the taking off of the power from the rim of the wheel or completely re-design wheels to meet the new conditions. It is particularly interesting to note that in nearly every one of these cases the wheels have been large in diameter and the speed of the engine slow or moderate. I have not on record a single case of a really high speed engine breaking either a fly wheel or transmission wheel. This I think is due to the fact that such engines always have wheels of small diameters traveling at high speeds, and the small diameter reduces the leverage upon the arms so as to bring them well within safe limits, for these particular strains when made large enough to take care of the ordinary ones.

Throwing on a sudden load, greater than the maximum for which it is designed, certainly should not wreck an engine, and I would point out that it does not seem to have been a matter of so much difficulty to design engines that will stand such a load. I have repeatedly seen engines developing over 300-hp, and running as high as 250 revolutions per minute, brought to a standstill in three or four seconds by a dead short-circuit on generators, and in many stations it is the regular practice (and in fact is a necessity) to throw the whole load off and on engines as quickly as switches can be thrown, and in such cases accidents are comparatively unknown. In rolling mills also it is a common occurrence to have an engine "stalled" by overload. In our business it is a regular practice when starting a new engine to throw the whole load off and on several times in quick succession just to be sure that the governor is working freely, and we are always glad when the engine is on electric service, since this affords such an easy and quick way of changing load. The question then is—is not the supposed safety of the slow speed engine largely a myth, and does not the question of immunity from accident lie in the use of small and heavy wheels at high speed rather than comparatively light and large wheels at slow speed?

Philadelphia, Pa. T. Carpenter Smith.

To the Editor of The Electrical World:

Sir: Since, from whatever cause, fly-wheel accidents do occur in electric power plants, resulting in almost complete destruction of equipment and building, it is but natural to look for some device or arrangement by means of which these disastrous results may be practically averted. Most engineers have given the matter considerable thought, knowing as they do the severe conditions of service, the numerous possibilities of defective fly-wheel castings, and faulty alignment of spokes and rim, placing the entire strain on only a part of the spokes and bolts entering into the built-up structure.

It is generally conceded that accident result from abnormal speeds, either coming from excessive steam admission due to a faulty governor, or by reversal of polarity in the generator such that it receives current as a motor, thus speeding up the engine independent of vacuum or steam supply.

As possibly one means of insuring against disasters of that kind, I would suggest the following: In addition to what is now used, place on the main shaft to the engine a centrifugal governor without belting or gearing, the weights of which revolve in a vertical plane around the shaft. When an excess of speed comes which the regular governor fails to check, the shaft governor would act instantaneously in throwing an electrical switch, which would shunt from the bus-bars of the station a current through an electro-magnet, this magnet automatically unhooking the valve gear or closing an additional throttle valve. At the same time the same current would pass through the coils of another magnet having its armatures attached to a switch on one of the leads from the generator which would automatically break the generator circuit, thus insuring against dangers, both from engine and generator.

The governor could be placed on the hub of the fly-wheel, being of the general form of those used in automatic engines. The magnets could be wound with heavy wire and large currents shunted into them, thus insuring great strength and promptness of action.

The apparatus would be exceedingly simple in construction and cheaply made; no trumped up "home made" arrangement, however, would do. The governor should be sensitive and of first-class workmanship and quality, because success would depend on its direct satisfactory action.

New York, N. Y. George H. Davis.

To the Editor of The Electrical World:

Sir: I have noted with interest the article on fly wheel accidents by Mr. Coykendall, in your issue of October 13.

The problem seems to be largely, if not wholly, one of inertia. In the case of the accident cited, I believe the fly wheel was used also as a band wheel (driving a belt). When the heavy short circuit was thrown on to the generator there was an enormous force instantaneously applied to the fly wheel, at the rim, tending to stop the rotation, but the momentum of the heavy spokes and rim resisted stoppage with such force as to rupture both rim and spokes Oftener in such cases the belt breaks. If the above wheel had been used simply as a fly wheel the accident might not have occured, as the force tending to stop the wheel would have been applied from the center and the strongest tendency would have been to shear the spokes from the hub, where there is usually ample material to resist such strains

Chicago, Ill. S. S. Howell.

To the Editor of The Electrical World:

Sir: I am greatly interested in the letters on fly-wheel accidents that have appeared in the columns of The Electrical World, and am sorry that all the writers seem to find fault with the Corliss engine.

Now, I have never seen a Corliss engine which would make more than two revolutions before the governor would have control, even if the full load was thrown off instantly. For by the time the engine had made two revolutions, the governor would have lifted so high that the steam valves would not open.

Prof. R. H. Thurston in his letter says "if the key should drop out of the governor pulley or the belt break, the engine is gone." Well, if an engineer had charge of the plant he would have the safety ring on the governor in its proper place, and the rest of his valve gear in order, and then when such a thing happened the engine would stop.

In my opinion the men who are put in charge over the engineers' department where these accidents occur are the ones to blame; for nine times out of ten they are responsible for the conditions that lead to accidents or employ men who do not understand their business. If the managers of some of our large electrical plants would dispense with the service of some of their so-called electricians, and pay fair wages to a competent engineer, they would have no reason to find fault with the governor or any other part of the Corliss engine.

GEO. E. O'NEILL.

Brooklyn, N. Y.

Symbols and Abbreviations.

To the Editor of The Electrical World:

Sir:—I have read the article in the London *Electrical Review* which contains Prof. Jamieson's criticisms of the system of all symbols and abbreviations recommended by the Chicago Congress, and I wish to make some observations in reply.

He objects to the French script letters, and would use instead block or Clarendon letters, because the latter are more common and more easily made. But this proposal violates one of the fundamental principles of the Congress system, namely, to use script or oblique letters as symbols for quantities and perpendicular letters for the names of units or their abbreviations. Block letters such as **M**, **H**, **B** are very suitable for representing general units, that is, units independent of any particular set of fundamental units; for example, **L** for any unit of length, **T** for any unit of time; **L : T** for the general unit of velocity. For purposes of instruction this use of block letters is very convenient, and, I believe, was first made in a volume of mine on *physical arithmatic*. By Clarendon letters I understand black letters, hooked at the ends and corners, as **L**, **T**; they were introduced into analysis by Heaviside for the purpose of denoting vector quantities. Would it be right to seize and appropriate for a different purpose, the type which the vector analyst has preempted, and which is required in the higher investigations of electrical science?

Prof. Jamieson is not satisfied with the length of the names ohm, dyne and erg, but would use ω, δ, ε, for short. But ω, δ, ε, are not abbreviation formed after the principle of the Hospitalier system; they are rather arbitrary marks. Besides, it is a principle of that system that Greek letters should be reserved for symbols, and the Frankfort Congress recommended a further restriction, namely, to denoting angles and physical constants.

As the sign for "per" he prefers the solidus to the colon, and gives as reason "A line, so /, always signifies *per* or $\div$ *by* in mathematics." This is not quite exact, and in a critic of the Congress system we expect the utmost precision. The sign / signifies *per* or *divided by*, and is equivalent to : . In the names for units it is the hyphen, not $\times$, which is used to denote the product connection; consequently where the quotient connection is to be expressed in a name, a sign other than the algebraic sign of division may be preferable. But, be that as it may, it is certain that the colon is the more ancient sign, and also that some of the innovations which have been introduced in connection with the solidus are far from being unobjectionable. The use of the solidus is subject to an ambiguity which has never been settled by a distinct convention. With some writers $a + b \,/\, c + d$, is used to mean $\frac{a+b}{c+d}$, with others to mean $a + \frac{b}{c} + d$. The latter, though not the usual, is doubtless the correct meaning; to express the former brackets are required, thus $(a + b) \,/\, (c + d)$. Why are the brackets unnecessary in the usual notation? Because the horizontal bar serves as a vinculum as well as the sign of division. Thus the linear plan of writing algebraic expressions labors under the disadvantage of requiring a more extensive use of brackets. Also, it is not so synoptic, for the field of exact vision taken in by the eyes at a glance is not a strip, but a circle. By its inventor, Stokes, the solidus was intended merely as a means of printing an algebraic expression linearly when it occurred in the middle of the text.

Prof. Jamieson objects to v, g, and mho as unnecessary, and prefers the reciprocal expressions $\frac{1}{u}$, $\frac{1}{R}$, and $\frac{1}{\omega}$. Were he logical he would write these $/u$, $/R$, $/\omega$. But it is not a new idea to express the reciprocal of a unit in the same manner as the reciprocal of a symbol. Any one, not a Gael, finds a difficulty in pronouncing *mho*, but how are we to pronounce $\frac{1}{\omega}$? Only by means of a many syllabled phrase.

He thinks ML^2 sufficiently concise for moment of inertia, and ml quite good enough for magnetic moment. Electricians, on the contrary, will hold that each of these quantities is of sufficient importance to demand a special symbol for itself. For electric power he considers that W_P is better than P, because the former signifies power in watts. But it is a principle of the Congress system that P as a symbol does not refer to any unit, and as a numerical value it may be used with reference to any unit of power, whether watt, or kilogrammetre per second. Besides W is the symbol chosen to denote work. For current he prefers c to i, because "intensity" has no meaning in the phrase "intensity of current." This objection was before the Committee of Congress, and as it is a matter not of error, but of preference, it is surely binding on electricians to accept their decision.

Thus it will be seen that the proposed modifications of Prof. Jamieson are based on personal preference, or on a failure to grasp or, at least, to respect, the fundamental principles of the recommended system. Their tendency would be to change a logical system of notation into a miscellaneous jumble of shorthand.

Ithaca, N. Y. ALEXANDER MACFARLANE.

A Question of Thermodynamics.

To the Editor of The Electrical World:

Sir:—On page 359, October 13th issue of The Electrical World, is a mistake which is seriously misleading to those not familiar with thermodynamics.

Assuming the constant 0.058 to be true, then $(331° - 80°) \times 104 \times 0.058 = 1{,}514$ nearly, and the equation $\frac{1{,}514 \times 778}{33{,}000} = 35.7$ hp is true, but the statement that 27½ per cent. of the available mechanical energy is lost through this amount of radiation is wrong. It is true there is a loss of energy that would be delivered at the fly wheel of the engine if the pipe were thoroughly covered to prevent radiation.

The extreme theoretical range of temperature in a non-condensing engine working under 90 pounds pressure, is $331° - 212° = 119°$, representing only 36.3 available heat units to be converted into mechanical energy from each pound of steam, which is but a trifle over 3 per cent. of the energy existing in the steam in the form of heat, considering water at 32° the basis.

Now, a conversion of a trifle more than 0.04 pound of steam of 90 pounds pressure into water of corresponding temperature, will give out as much energy in the form of heat as is received in the form of mechanical energy from one pound of steam expanding from 90 pounds pressure down to atmospheric pressure.

The loss of 35.7 hp by radiation, in the pipe in question, can be fully accounted for by the presence of but little more than 4 per cent. moisture at the engine. And a test will show, that instead of materially lowering the temperature of the whole body of steam as implied, the loss will be made manifest by the presence of moisture, and the actual loss will fall from 27½ per cent., as stated, to perhaps less than 5 per cent.

Fredonia, Ill. FRED W. RICHART.

To the Editor of The Electrical World:

Sir:—The criticism of Mr. Richart's is just. The temperature given corresponded to saturated steam and in that case his remarks are correct.

While making the statement I had in mind the case of superheated steam in which the heat of the superheat is the first to go and is practically foot-pounds at the engine. A more careful revision of the statement would have corrected this error. If a good fireman and a well designed boiler are so fortunate as to supply superheated steam, the advantage should not be lost by unclothed steam pipes.

Providence, R. I. GEORGE T. HANCHETT.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Action of Alternating Currents on Dielectrics.—Continuing the discussion on this subject Mr. Addenbrooke, in a communication to the Lond. "Elec. Rev.," Oct. 5, quotes from Geipel & Kilgour's pocket-book a table giving the results obtained by Siemens Bros. & Russell, for the sparking distance in inches between planes, from which he deduces the fact that the sparking distance in air for alternating currents, is, under the same circumstances, equal to about the square root of two times that of continuous currents, or nearly half as great again; the statement that the sparking distance in air for alternating currents was practically equal to that of a continuous current of the maximum pressure of the alternating, is therefore correct. Good comparative tests are wanting, however, to show whether their relative sparking distances are maintained in solid or liquid dielectrics. Siemens Bros. found that the sparking distance for rubber covered cables was about one-third that of air; Prof. Hughes showed that some resinous oils have a dielectric strength from 50 to 80 times that of air. A film of 1-250th of an inch will withstand a pressure of 10,000 volts. As mechanical conditions require at least 1-10th of an inch of insulation, the dielectric strength of materials and cables for 2,000 volts for instance, is enormously in excess of the sparking distance. In air it would be 1-35th of an inch, therefore in rubber about 1-175th, and in good resinous oils about 1-10th of this. The sparking distance across an exposed surface, however, may be three times this distance, and it is across such surfaces, the insulating qualities of which have been deteriorated by electrolytic or atmospheric influences, that breakdowns occur, but whether there is a greater tendency for such action with alternating than with continuous currents, is still undecided, and he agrees with Prof. Thompson that, taking all things into consideration, the difference in practice may be considered negligible. He gives the opinion of a superintendent at the Callender works, who states that as far as he knows there is no difference; he concludes that there is in this direction no commercial reason for considering alternating currents inferior to continuous.

Dielectrics.—A Physical Society paper, by Mr. Appleyard, is published in the "Phil. Mag." for October. He states that electrification seems to be the net result of many simultaneous actions, some of which are very obscure, and there is no theory to adequately account for the phenomena. The paper presents some of the difficulties encountered in an attempt at a solution, in the form of experimental results. Among other things he finds that a celluloid sheet pressed between two metallic surfaces has a negative electrification, but when between mercury surfaces there is no electrification. He discusses dielectric hysteresis, residual charge, experiments with gutta-percha, and a sensitive dielectric made of a mixture of brass and gutta-percha. In the latter he finds there is a critical point in the proportions, above which it has a very high resistance and below which it has a very low resistance. This proportion seems to be two parts by weight of brass and one part of gutta-percha.

Velocity of Cathode Rays.—A paper by Prof. J. J. Thomson, published in the "Phil. Mag." for October, is abstracted in the Lond. "Elec.," Oct. 5. He describes experiments made to determine the velocity, as a knowledge of this enables one to discriminate between the two views as to the nature of cathode rays. He finds that the velocity is about 1.9 multiplied by ten to the seventh power in centimeters per second. This is small compared with the velocity of the main discharge from the positive to the negative electrode. The velocity is about 100 times as great as the velocity of the mean square of the molecules of hydrogen at zero degrees C.

Velocity of Ions.—A paper by Mr. Whetham, on the velocity of ions and the relative ionsiation-power of solvents, is contained in the "Phil. Mag." for October. He shows by experiment that the velocity of the ions is reduced in about the same proportion as the conductivity, and that in the case under consideration the conductivity can be calculated from a knowledge of the opposite ionic velocities. His experiments suggest that the specific inductive capacity and the viscosity are the chief factors in determining the relative ionisation power of a solvent.

Movement of Pure Ether.—A mathematical article by von Helmholtz, from "Wied. Ann.," vol. 53, p. 135, on the consequences of the theory of Maxwell regarding the movement of pure ether, is published in "L'Eclairage Elec.," Sept. 29.

Propagation of Electric and Magnetic Perturbations.—Mr. Blondin's mathematical article is continued in "L'Eclairage Elec.," Sept. 29.

Electron or Atom of Electricity.—In a communication to the "Phil. Mag." for October, Dr. Stoney claims that he, and not Helmholtz, was the first to call attention in 1874 to a unit or atom of electricity which he called an "electron," and which he found was equal to 10 to the minus 20th power part of a coulomb, or 3 multiplied by 10 to the minus 11th power of the electrostatic unit of quantity. A more recent estimate of Prof. Richarz is 12.9 in place of 3 in the last named value.

Unipolar Induction.—A paper, by Dr. Lecher, from the "Wiener Berichte," July 12, is very briefly abstracted in the "Phil. Mag." for October. It contains historical and general observations, showing that neither previous experiments nor more recent modifications can settle this question. He describes the following crucial experiment: "A magnet is divided by an equatorial section in two parts, each of which can rotate separately. By means of suitable spring contacts it is possible to obtain from the two ends of the magnet an induction current which cannot possibly be due to a cutting of the rotating lines of force in the short fixed spring contacts. The current is easily explained if we adopt the view of Farady which, however, he afterward abandoned, that the rotating magnet cuts its own fixed lines of force, and thus has an electromotive action."

Origin of Earth Currents. A paper by Prof. Bachmetjew, of Sophia, is begun in the "Zeit. Feur Elek.," Oct. 1. Nothing of importance is given in the first section other than a brief resume of papers published.

MAGNETISM.

Steel vs. Iron.—An editorial in the Lond. "Elec. Eng.," Oct. 5, calls attention to a new and peculiar form of cast steel intended for a dynamo, recently tested by Mr. Kapp and Prof. Ewing, and which is said to have given excellent results, chiefly in giving a high permeability at strong magnetizations, it being considerably higher than that of good wrought iron. According to Prof. Ewing, the permeability at low magnetic forces is less than that of wrought iron, but the reverse is the case with high forces. From $\mathcal{B} = 14,000$ upward its permeability is superior to that of iron forgings, and there will consequently be more magnetism for given exciting current. For $\mathcal{H} = 40$, $\mathcal{B} = 17,000$, as against 15,000 to 16,000 in wrought iron, while an induction of 18,000 may be reached with a magnetising force of 68, whereas ordinary wrought iron would require 125 for the same induction. The hysteresis loss is also better. It can be made remarkably free from blow-holes, and excellent surfaces can be obtained for the castings. The Lond. "Elec." also calls attention to this subject, and mentions the firm of Edgar Allen & Co., as makers of a material, whether steel or iron, is not stated, on which Prof. Ewing made some reports (whether this is the same as the steel above referred to is not stated, but it is not unlikely that it is).

Circular Magnetization of Iron Wires.—A paper by Prof. Klemencic, from the "Wiener Berichte," July 5, is abstracted very briefly in the "Phil. Mag." for October. He finds that the susceptibility of soft annealed iron around the axis is less than in the direction of the axis, and the residual magnetism has greater values with circular than with axial magnetization.

Magnetism of Hollow Cylinders.—Mr. Kalischer replies in the "Elek. Zeit.," Oct. 4, to the recent article of Mr. Grotrian abstracted in the Digest Sept. 15, stating that the experiments which that writer described were largely made and described by Faraday. An abstract from Faraday's works is given in full, and it is stated that he suggests a complete analogy with the inner space of a metallic vessel charged with electricity.

Magnetic Properties of Asbestos.—Mr. Swinton, in a communication to the Lond. "Elec. Rev.," Oct. 5, cites some recent experiments showing that with a strong electromagnet a piece of white asbestos board, weighing about half an ounce, was easily lifted through a vertical distance of 1.5 inches, and that in contact with a manget it would support four ounces additional weight; also that it is easy to magnetise it permanently. He thinks it is due to the oxide of iron which is contained as an impurity, but adds that the degree to which it is magnetised seems surprising. Asbestos should, therefore, not be used in delicate instruments, where a permanent magnet introduces an error.

Magnetic Constants of Soft Iron.—Some errors were contained in a table published in the article by Dr. Froelich, and mentioned in the Digest Oct. 13. The "Elek. Zeit.," Oct. 4, publishes a corrected table.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Board of Trade Laboratory.—A well illustrated description of the standard ampere balance, showing its construction, is published in the Lond. "Elec.," Oct. 5. It consists of a coil suspended from the arm of an accurate balance, and situated between two fixed coils. The descrip-

tion is quite complete, including the dimensions and data of the coils. A description of the volt standard is promised. The Lond. "Elec. Eng.," in continuing its article on this laboratory, also gives a description of this ampere standard, including illustrations of some further details. It also describes at some detail, and with illustrations, the 100 volt standard voltmeter, made somewhat on the principle of Sir Wm. Thomson's quadrant electrometer with ten parallel vanes. Some other instruments are also described and illustrated. The article mentioned in the Digest Sept. 29, is continued in the Lond. "Elec. Rev.," Oct. 5. The present section is devoted to a description of the several rooms in the Board of Trade Laboratory at Whitehall. An illustration of the Standards Laboratory and one of the Verification Room, is given.

Electrical Standards.—The final reportof the British Committee is published in the Lond. "Elec. Eng.," Oct. 5. It refers to the specifications for the preparation of the Clark cell.

Construction of Resistances.—Mr. Morris' paper is concluded in the London "Electrician," Oct. 5. He discusses carbon plate rheostats, liquid resistances, and step-by-step resistances. In giving the formula for the heating, he gives the rough and ready rule that with a permissible rise of temperature of 60 degrees C, the watts which can be absorbed per meter are equal to 20 times the diameter in centimeters, or 50 times the diameter in inches. It does not depend on the material. It corresponds to about one watt per 16 square centimeters of surface. Dr. Fleming found that with rods of plumbago and plaster of Paris, it was possible to dissipate one watt with six sq. cms. of surface. He gives illustrations from the paper of Mr. Dettmar (see Digest Jan. 6, under "Kruppin"), showing the spacing of the convolutions of spiral resistance for most rapid cooling, absorbing maximum watts per meter of wire (the data here given appears to be either insufficient or not quite clear). He also gives an illustration of a manganese wire resistance designed by Dr. Fleming for dissipating 3-hp.

Galvanometer.—A new Ayrton-Mather galvanometer of the d'Arsonval type, for test room work, is illustrated in the Lond. "Elec.," Oct. 5. A somewhat fuller description is given in the Lond. "Elec. Eng.," Oct. 5.

Thomson Bridge.—An illustrated description of a bridge for measuring the resistance of large bars, together with a complete diagram of the connections, is published in the Lond. "Elec. Rev.," Oct. 5.

Kruppin.—The "Elek. Anz.," Oct. 4, gives the constants of this resistance wire, but the article seems to contain nothing that has not been published before.

Theory of Wimshurst Machines.—In a French Academy paper, by Mr. Shaffers, abstracted briefly in "Cosmos," Oct. 6, he points out certain modifications and simplifications. His conclusions are that straight combs in front of a single plate replace perfectly the horse shoe combs, and that the use of a diametrical conductor in front of each plate will double the efficiency (output?) of the machine. The conclusions were verified by experiment.

Photographing Telephone Oscillations.—Mr. Burch's experiments mentioned in the Digest Sept. 15, are described briefly in the "Elek. Zeit.," Oct. 4. With his arrangement frequencies of 2,500 to 3,000 can still be distinguished from each other.

Measurements with Electrical Radiation.—Dr. Zehnder's paper, mentioned in the Digest Oct. 6, is abstracted briefly in the Lond. "Elec.," Oct. 5.

Electrical Method for Testing Dynamos and Motors.—A French translation of the article by Mr. Lenz, abstracted at some length in the Digest Sept 8, is published in "L'Eclairage Elec.," Sept. 29.

ARC AND INCANDESCENT LIGHTS.

Double Series Arc Light System.—In the "Elek. Echo," Oct. 6, Mr. Schulze describes a system in which a second series of arc lamps is connected to a series wound dynamo in parallel with the first series, which may be accomplished by shunting the field magnets with a fixed resistance, which must be somewhat greater than that of the magnets. When one group of lamps is cut out, this resistance must also be cut out. An apparatus for doing this and the reverse operation automatically, is described.

Light for Photographing.—The Lond. "Elec.," Oct. 5, mentions a system in which 40 incandescent lamps of 25-cp, were placed under a white dome reflector about 3.5 ft. in diameter. The lamps were nominally 65 volts, but were run up to 100 volts during exposure. It is claimed that an exposure of one second will suffice for a portrait. The forced lamps give a fairly good actinic light, and the apparatus seems easy to control.

TRANSMISSION OF POWER.

Polyphase Transmission.—The Lond. "Elec. Eng.," Oct. 5, calls attention to a plant which is being erected at Foligno, Italy, containing three generators and turbines of 100-hp each, generating a current of 2,000 volts. The distance is 4.34 miles. One circuit is to be used for lighting, and the other for motors. It is to be installed by the Oerlikon Company.

Power Transmission in the Transvaal.—A few figures regarding some proposed installations, in one of which 20,000 volts are to be used, are given in the Lond. "Elec. Rev.," Oct. 5.

ELECTRIC RAILWAYS.

Accumulator Traction in Mines.—A paper, by Mr. Libert, read before a Belgian Society, is published in "Ind. & Iron," Oct. 5. He describes an installation carried out last year in an important colliery in the Charleroi district. The paper is quite long, and is well illustrated. Accumulators are used, as a trolley line could not be employed in mines subject to fire damp on account of the sparking.

Electric Traction in the Paris Sewers.—Visitors are taken through the large Paris sewers on a system of railways which have heretofore been run by man power. "L'Eclairage Elec.," Sept. 29, publishes a well illustrated description of an electric locomotive, which is at present being built for driving these cars. It is run by accumulators.

Railways in Vienna.—The "Zeit. feur Elek," Oct. 1, publishes a large map of Vienna, showing the railway systems, accompanied by propositions made by the Electrical Society of that city for the introduction of electric traction. A table gives the number of trips per inhabitant per year on the city railways in some of the largest cities, for 1891, and is as follows: New York, 267; Berlin, 140; London, 116; Hamburg, 90; Paris, 84; Budapest, 59, and Vienna, 46.

Elevated Railway in Berlin.—An editorial in the "Elek. Zeit.," Oct. 4. states that the firm of Siemens & Halske will, in a few days, begin the construction of an elevated electric railway running through Berlin from East to West.

Underground Gravity Road.—According to the "Elek. Anz.," Oct. 4, Mr. Grauel suggests an underground gravity road for the city of Berlin, built in lengths of 3,000 to 6,000 ft., on which power may be used in addition. The greatest allowable speed is given as 1.4 miles per minute.

Waterloo City Railway.—A note on this underground electric railway, which is at present under construction, is contained in the Lond. "Elec. Eng.," Oct. 5. It is referred to briefly also in the "Elek. Zeit.," Oct. 4.

Brussels Railway.—A brief description of the electric railways is published in "L'Elec.," Sept. 29.

Sectional Contact Rail System at Lyons.—The Lond. "Elec. Eng.," Oct. 5, publishes some of the illustrations, with a brief description of the system mentioned in the Digest last week.

Trolley Navigation.—A system used by the firm of Siemens & Halske for supporting the trolley wires on floating buoys for use in lakes and like places, is illustrated in "L'Eclairage Elec.," Sept. 29.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Regulating the Phase in Alternating Current Circuits—In a communication to the "Elek. Zeit.," Oct. 4, Mr. von Dobrowolsky, in referring to Mr. Imhoff's article, abstracted in the Digest, Oct. 13, calls attention to the fact that the over-excitation of alternating current motors in place of condensers for shifting the phase, was known since 1891, when it was described by Mr. Swinburne. The first practical application was made a year and a half ago at his (Dobrowolsky's) suggestion on the Buelach-Oerlikon transmission plant; here the 200-hp three-phase motor of a somewhat old design, was found to consume such a large wattless exciting current, that the primary station, the line and the transformer, were overloaded and the installation could neither operate economically nor be fully loaded; an over-excited synchronous motor at the secondary station, was inserted in the branch circuit behind the transformers, which completely overcame all the difficulties; he claims therefore to be the first to carry out the suggestion practically. He also claims to be the first to patent, in most countries two years ago, the regulation of the phase difference between parallel alternators by changing their relative excitation, as also to introduce phase indicators; the only thing original in Mr. Imhoff's system is the use of the exciting dynamo at the same time as a generator of the wattless current. In an editorial, attention is called to the fact that Dr. Hopkinson in an Institution paper, several years previously to Mr. Swinburne, showed that in a synchronous single-phase transmission, the motor should be excited more than the generator; whether the results gained are warranted by the extra cost must be determined for each case, in most cases this method may show itself to be cheaper, or at the same cost give a higher efficiency; an additional advantage is that a strongly excited motor will not fall out of synchronism with a sudden overloading as one that is weakly excited. With induction motors the regulation of a phase involves increased first cost, as the regulation cannot be affected by the exciting of the motors but requires the addition of a special machine, as described by Mr. Imhoff, in the form of a synchronous motor excited to give a higher voltage than the main current, and which is installed in the receiving station and connected in parallel with the non-synchronous motors; whether this introduction is warranted by the expense must be determined for each case.

Rectifiers.—An editorial in the "Elek. Zeit.," Oct. 4, calls attention to the increasing introduction of rectifiers in England in cases where comparatively few arc lamps are to be run from an alternating current station; such an apparatus requires less space and supervision and is cheaper in first cost than a special engine and an arc light dynamo would be; whether this somewhat complicated apparatus is better will be shown by the experience in those stations.

Hempstead.—An illustrated description of this municipal plant, which

is said to be the first one in the Metropolis installed by the municipality itself, is published in the Lond. "Elec. Rev.," Oct. 5. A somewhat fuller description, including a number of illustrations, is published in the Lond. "Elec. Eng.," Oct. 5.

Arundel.—A well illustrated description of the installation at Arundel Castle, which is the largest private installation in England, is given by Mr. Kapp in the "Elek. Zeit. " Oct. 4 (see also Digest, Set. 8).

Worcester.—The Lond. "Elec.," Oct. 5, gives an illustrated description of this station, which is run by water-power.

Ealing.—The switchboard at this installation (see Digest last week) is illustrated in the Lond. "Elec. Eng.," Oct. 5.

Halles.—A translation of Mr. Claude's (article see Digest, Aug. 18) describing and discussing the more recent alterations in this station, is published in the Lond. "Elec. Rev.," Oct. 5.

Lyons Exhibition.—"L' Eclairage Elec.," Sept. 29, publishes an illustrated description of three small stations for the lighting of this Exhibition.

Design and Specification for Electric Lighting Works.—What appears to be a book on this subject for Architects and Civil Engineers by Messrs. Pentland & Gibbings, is being reprinted in London "Electricity," beginning with Oct. 5.

Mercury Commutator.—The Siemens & Grunston form is illustrated in "L'Eclairage Elec.,"Sept. 29; the mercury is covered with a layer of sand which prevents oxidation and the formation of sparks.

High Pressure Turbine.—A short illustrated description of a Van Rysselberghe high-pressure turbine is given in the "Elek. Anz.," Sept. 30.

Utilization of Town Refuse for Generating Steam.—A paper by Mr. Baker, is published in full in the Lond. "Elec. Eng.," Oct. 5.

WIRES, WIRING AND CONDUITS.

Leads for Three-phase and Single-phase Systems.—In an article in the "Rev. d'Elec.," Mr. Chavannes shows by calculation that the belief that in the three-phase system there is a saving of 25 per cent. of copper at the same maximum potential is erroneous, and that the weight of copper is absolutely the same in the two systems. He states that if in a single-phase system the mean potential between a wire and the earth is 500 volts it will be 1,000 volts between the wires, while in a three-phase system if each wire has a mean potential of 500 volts relatively to the earth, that between two of the conductors will be 866 volts; these two cases cannot be compared in determining the cost of the copper as they should be compared at the same volts and not at the same potential between the line and the earth, which latter has no significance, even in calculating the insulation, as that should be calculated on the basis of one of the conductors being connected to the earth, in which case the two voltages would be 1,000 and 866; the two systems should be compared for the same E. M. F., indicated at the voltmeters at the station; by taking the above case he finds that the copper in the tri-phase system will be to that in a simple system as two is to the square root of three, which is quite different from a saving of 25 per cent. He calculates an actual case for transmitting 100-hp with 10-hp lost in the lines and a voltage of 1,000 at the station; in the single-phase system the current will be 73.6 amperes and the resistance will be 0.68 ohms for one lead; in the tri-phase system the current will be 245 amperes, or as each of the conductors supplies two circuits, the current in each will be 49 amperes and the resistance 1.02 ohms; from this he concludes that the weight of the copper of the two lines is exactly the same as that for the three lines, showing that the systems are identical; the only difference is that the potential of the tri-phase lead relatively to the earth is 580, while for the single-phase system it is 500.

Protecting Fuse.—An arrangement devised by Mr. Wahlstroem is described in the "Elek. Anz.," Sept. 30, and is intended for cases in which the fuse wire would be too thin to be practicable; he uses a short carbon filament, to which are fastened two thin metallic wires; a strong current will fuse the carbon and if this does not stop the current an arc will be formed, which will burn off the metallic wires until the arc is of such a length that it can no longer be maintained.

Double Wire.—The Grammont system is described and illustrated in "L'Energie Electrique," Oct. 1; two well-insulated wires are kept apart by a flexible material and the whole is enclosed with a braiding, forming a double flexible cable, which is nailed directly to the walls through holes in the bridge piece made for that purpose.

Underground Wires.—According to "L'Eclairage Elec.," Sept. 29, the General Electric Co., of Berlin, has adopted a new system in which the conductors are contained in conduits formed of a metal spiral surrounded by a porous covering which drains off the water.

High Tension Insulator.—The Ferranti system is illustrated in "L'Eclairage Elec." Sept. 29; the wire is secured transversely to a stretched vertical support made of some fibrous material, which is continually kept saturated with oil.

Rules and Regulations.—"L'Energie Electrique," Oct. 1 (vol. 1, No. 1), begins to publish the laws of France concerning the running of the leads of all sorts in public streets.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction Systems.—An editorial in the "Elek. Zeit.," Oct. 4, calls attention to the results obtained by Preece and Stevenson, and states that the views of the latter that coils are better than parallel wires, is in general not correct; when weak currents are used coils will, in most cases, give the best results, but when stronger currents are used parallel wires would doubtless always be the best. The limiting distance for such communication has been increased from 1.8 to 4.8 miles. It suggests the use of such a system in case of war; if for instance, in the neighborhood of a fortress several wires are laid in the sea, of which one carries an alternating current, the induction on the others will be appreciably changed as soon as an iron vessel approaches the wires.

Trans-Atlantic Telegraphy.—In the note on trans-Atlantic telephony in "L'Elec.," Sept. 29, a suggestion by Mr. Adderis given for utilizing the telephone as a telegraphic receiver; at the receiving station the lines divide into two branches connected to two interrupters which have different rates of vibration; the arriving current will always meet a current in the same direction in one of these branches and a current in the opposite direction in the other, increasing the sound in the telephone in one of the circuits and decreasing it in the other; both telephones are held to the ear; a positive current, for instance, corresponds to an increase in the sound and a negative current to a decrease, thus enabling the signals to be distinguished from each other; the chief objection is that no record can be kept.

Telegraphy in Great Britain.—The "Elek. Zeit.," Oct. 4, contains an article by Mr. West, giving a history from 1837 up to the present time.

Telephone Switchboard.—Mr. Engelmann, in the "Elek. Zeit.," Oct. 4, describes and illustrates an arrangement by means of which certain objections are overcome, especially when the circuit includes two central stations.

Tower for Overhead Wires.—In an article by Mr. Pellissier in "La Nature,"Oct. 6, he gives an illustrated description of the tower for overhead wires on the Telephone Central station at Antwerp.

Time Distribution.—The system which is now being introduced in Berlin, and in which compressed air and electricity are used, is described in the "Elek. Anz.," Sept. 30; the clocks are set every four hours and the charge is 50 cents per month per clock.

ELECTRO-CHEMISTRY.

Electro-chemical Preparation of Accumulator Plates.—In the "Electrochem. Zeit." for October, Dr. Schoop gives an interesting summary of all the various forming processes which have been applied in practice. They are briefly as follows: Epstein boils the lead plates for several days in a solution containing 1 per cent. of nitric acid; after the coating is one millimeter thick the plates are dried in the air; the last traces of nitric acid are removed by placing the plates as cathodes in a dilute solution of sulphuric acid containing some copper sulphate and passing a current until the lead is completely reduced to spongy lead; the plates are then peroxidized in sulphuric acid containing pyro-tartaric acid. Dujardin forms the plates directly in a moderately concentrated solution of sulphuric acid and nitrate of sodium; Lucas removes the last traces of nitrates by treating the plates with ammonia and then heating them to above 200° C. Boettcher uses a forming mixture of sulphuric acid, acetic acid and water. Swan produces a coating of white lead by the well known white lead process. Duncan produces a coating by making the plates the anodes in a bath of a solution of oxide of lead in potash. Schoop states that in several days lime water will produce a moderately deep action. If lead plates are electrolyzed in a solution of lead sulphate in pyro-tartarate of ammonium, at a certain current density and temperature a strongly adherent crystalline peroxide will be formed on the cathode. Perhaps the surest way of loosening the surface of the lead is by using a solution of bisulphate of sodium and chlorate of potassium, taking five parts of the former, 0.7 parts of the latter and 95 parts of water; plates about 4 in. square are treated with ⅓ ampere for 72 hours at 25° C.; when the action has penetrated about two millimeters, the coating is reduced to spongy lead in a 5 per cent. solution of sulphuric acid with one ampere; they are then thoroughly washed and heated in the air to nearly the melting point of lead. Plates may also be prepared in an electrolyte of sulphate of ammonium and hydro-fluoric acid. He describes the Howell process used by Crompton, in which kitchen salt is stirred into molten lead when near its point of solidification; this mass is then sawed into plates and the salt then dissolved out. The proposition to make an alloy of lead and zinc and then dissolve out the zinc, does not seem to have been carried out. An amalgam of lead from which the mercury has subsequently been removed, does not appear to be practicable. Rechanzaun prepares the surface of the plate by causing an arc to be passed over it, which melts the surface and oxidizes it. In conclusion he states that it is more profitable to peroxidize plates by an electro-chemical process than to use mechanically applied material.

Chemical Theory of Accumulators.—In the third article of Mr. Wade, in the Lond. "Elec.," Oct. 5, he describes the laws of Faraday and Lord Kelvin by means of which the E. M. F. may be calculated, and applies them to a number of the theories of the action in the lead accumulator, showing that in every case the calculated E. M. F. falls far short of what is required.

Guaranteeing Accumulators.—An article in the "Electrochem. Zeit.," for October, discourages the practice of guaranteeing accumulator installations, as it involves a loss of capital either to the consumer or to the manufacturer, and is an admission that accumulators require a guarantee.

Velvo Battery.—In the Lond. "Elec. Rev.," Oct. 5, Mr. Barnet replies to some criticisms of his Velvo carbon battery (see Digest, Oct. 6, 13, 20). He finds that one cent's worth of mercury is sufficient for amalgamating each pound of zinc; he does not see how a percentage of efficiency for zinc consumption can possibly be given in any other way than ampere-hours, as there is no theoretical limit to the E. M. F. and consequently to the watts obtainable; the efficiency of a battery should be expressed in terms of all the materials used, and if a pound of chromic salt is used to save a pound of zinc the loss in economy is apparent. From a description begun in London "Electricity," Oct. 5, it appears that the velvet-like carbons for this battery are platinized before carbonizing so as to form a finely divided platinum coating on the velvet-like surfaces; the other features of this battery have already been described in these columns.

Chlorine and Soda.—In an article in the Lond. "Elec. Rev.," Oct. 5, Mr. Andreoli criticizes a recently published description of the Castner process (see Digest, Oct. 13, 20); he states that there is no radical difference in this apparatus, as it is like that which was and is still used in the electrolysis of fused salts; the use of a moving body of mercury is not new, as all electro-chemists who have used mercury have used it in that way; he claims that it is not the only process which generates no hypochlorite nor the only one in which an efficiency of 88.9 per cent. is obtained. He quotes from the "Engineering and Mining Journal" of New York, Sept. 22, in which a description by Mr. Castner is published; he admits that the Castner process may be extremely good, but claims that it is not better than any good process based on the employment of mercury.

Production of Chlorate of Potash.—Two electrolytic processes are described in the "Elek. Tech.," Sept. 30.

Enamelling.—The Haswell process is mentioned but not described in the "Elek. Tech.," Sept. 30; it consists in coating metals, like iron and steel for instance, electrolytically, with a very hard and resisting metallic oxide. One of the advantages seems to be that any flaws or cracks, even when invisible, are brought out by the process; the absence of such flaws is therefore guaranteed when objects have been coated by this process; for this reason it is suggested to use it for the axles of railroad cars, as an assurance against the existence of flaws.

Testing Baths.—Dr. Krueger begins an article in the "Electrochem. Zeit.," for October, in which he calls attention to the great importance of frequently testing the constituents of plating baths; he intends to describe some simple methods requiring but little knowledge of chemistry. To determine the amount of metal in a bath he recommends the electrolytic method.

Tin from Tinned Iron.—"L'Eclairage Elec.," Sept. 29, mentions that according to a recent patent, tin plate is heated in soda and sulphur or in a solution of sulphide of sodium, for forming the sulphostannate of soda; to this solution ammonia, or sulphate of ammonia, is added, after which the bath is electrolyzed.

Aluminium.—The Nauhausen (Switzerland) plant is at present producing three tons per day and has reduced the price to 36.4 cents per pound.

MISCELLANEOUS.

Electricity in Aeronautics.—In an editorial in the Lond. "Elec. Rev.," Oct. 5, attention is called to the great danger to the life of the operator in making experimental trials, and it is recommended that Mr. Maxim and others should perform their experiments with electric motors connected to the ground with cables, as in that case the element of personal danger is practically eliminated and the whole machine could be actuated and directed from a safe distance. Attention is also called to the afact that an electric motor is at least as light per horse-power as any other motor. Mr. Trouve has constructed an electric motor developing at the rate of one hp for each 7 pounds of weight (the total hp or the total weight is not given).

Application of Motors.—In an article begun in the Lond. "Elec. Rev.," Oct. 5, a description, accompanied by a large number of good illustrations, is given of the application of motors in factories for various purposes. The description includes the application to a number of cranes.

Electricity on the Stage.—According to the "Elek. Zeit.," Oct. 4, the Court Theatre in Munich is installing a plant by means of which all the mechanical work on the stage is to be done by electric motors.

Electric Heating.—An illustrated description of a device is shown in the Lond. "Elec. Rev.," Oct. 5. The vessel is either conducting or contains a ring of conducting material, such as lead or fragments of carbon. This forms the secondary of a coreless transformer placed directly beneath the apparatus (a similar suggestion has been made several times before).

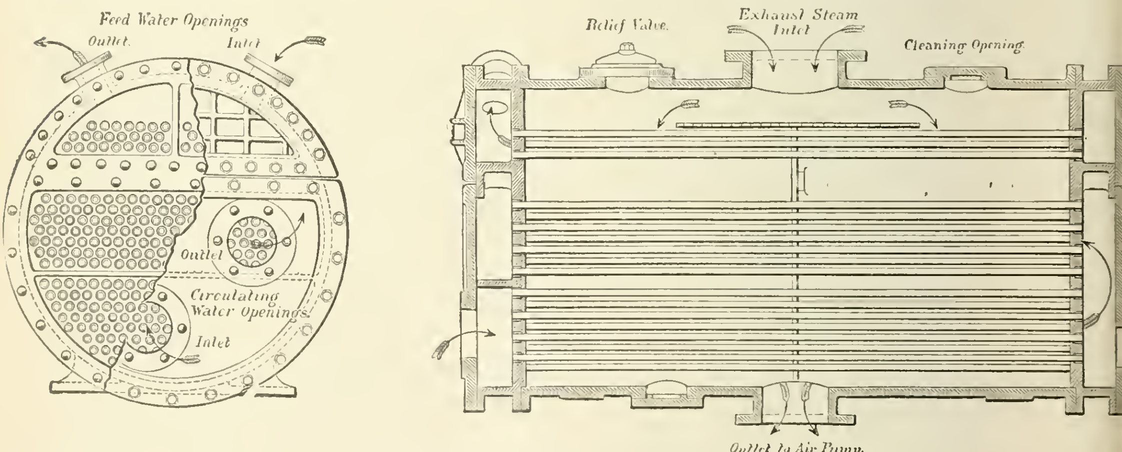
Taussig Smelting Process.—A brief description, taken apparently from the United States Consular reports, is published in the Lond. "Elec. Rev.," Oct. 5.

Electrically Lighted Life Buoy.—The Meller system adopted by the General Electric Co., of Berlin, is described in the "Elek. Anz.," Oct. 4.

Lightning Flash.—The Lond. "Elec.,' Oct. 5, reproduces a photograph of a flash of lightning taken in the day time, showing a broad band with a bright edge. It also reproduces an illustration from Prof. S. P. Thompson's paper, on the discharge of an influence machine, showing bright illuminated points at the corners of the zigzag paths.

The Volz Condenser and Feed-Water Heater.

The Volz patent combined surface condenser and feedwater heater (formerly furnished by The Standard Condenser Company) is now offered by the Wheeler Condenser & Engineering Company, which has purchased the patents covering this apparatus. They have also made arrangements with Mr. Wm. E. Volz, the patentee, to represent its interests in this connection as sales agent, together with the Wheeler condenser and other of its specialties, and is placing upon the market a line of apparatus which is in keeping with the rapid advancement of steam engineering.



COMBINED SURFACE CONDENSER AND FEED WATER HEATER.

The advantages of a simple and efficient feed water heater have long been recognized as a desirable auxiliary to both stationary and marine engines, not only for the purpose of economizing fuel, but also of insuring a longer life of boilers.

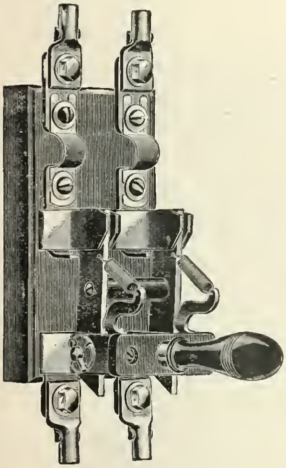
This object has heretofore been attained when using a surface condenser, by independent or separate feed water heaters placed between engine and condenser. These are expensive and require considerable extra space, besides often impairing the vacuum in the condenser because of contracted steam passages.

The most important feature of the company's patent combined surface condenser and feed water heater, is the combination of a surface condenser with a feed water heater—the latter being a simple, efficient and compact apparatus built within the condenser casing and herewith briefly described. The exhaust steam from the engine passes through the exhaust pipe in the usual manner, enters the top of the condenser and expands over the upper or heater tubes, imparting the heat through the medium of these tubes to the feed water; then passes to the lower o

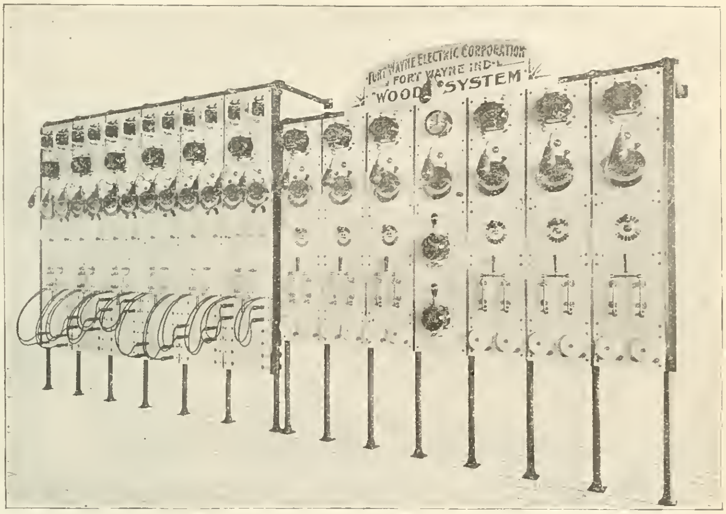
condenser tubes, where, after condensation, the water is returned from air pump and hot well to the feed water heater, and thence to the boilers.

As the hottest steam in this case meets the hottest water, avoiding the sudden change of temperature between exhaust and circulating water, experience has shown that the condenser tubes are more durable, and the vacuum more uniform in this type of condenser than without the feed water heater. Heater and condenser tubes are usually of the same diameter, but the former are made heavier; the feed water is split up in many small streams, extracting all the available heat from the exhaust steam, and ample provision is made for the proper expansion of the tubes. The condenser is fitted with automatic relief valves and may be operated with or without the feed water heater. The tube heads, feed and circulating water chambers are made in one composition casting with all division plates cast in, thereby avoiding joints between the feed and circulating water; separate heads or bonnets are provided, allowing access to either set of tubes; this efficient combination of heater and condenser is the result of close study gained by long experience.

The condensers are now used in many of the large electric light and power plants, and other establishments; also on many steam vessels where they were first introduced and are said to have given excellent results in every instance.



COPER SNAP SWITCH.



SECTIONAL ALTERNATING SWITCH BOARD.

New Station Switches.

The General Electric Company announces a new line of station switches to meet the demand for a reliable switch, which, though sold at a low price, will nevertheless be as durable and effective in work as the higher priced goods. It is known as the Coper Snap Knife switch and differs from the generality of station switches in that the contacts and lugs, instead of being of cast metal, are of pure copper stampings, the contacts having ample surface to avoid heating and consequent loss. The hinges of the blades which move in the back contacts are so designed as to give excellent conductivity. The handle and cross bar are connected to the blades by strong spiral springs, which pull the blade out, with a quick break action, only after the spring is in considerable tension. Thus the danger of arcing is reduced to a minimum. The switches are mounted on bases of hard white porcelain, made by the General Electric Company at its own works at Schenectady, and are constructed in sizes from 75 amperes to 300 amperes, double and triple pole, with and without fuse holders.

Wood Sectional Switchboard for Alternating Systems.

We illustrate herewith the new sectional alternating current switchboard designed by Mr. J. J. Wood, and built by the Fort Wayne Electric Corporation, of Fort Wayne, Ind., for a plant at Austin, Texas.

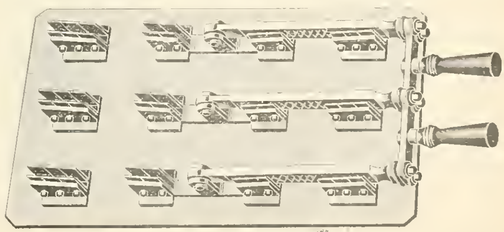
This board is constructed in two main sections, one of which is designated the "dynamo" board, and the other the "distributing" or "feeder" board. Each of these sections is built up of independent panels, each panel representing either a dynamo circuit complete or a feeder circuit complete. The panels are fitted with primary fuse boxes, ammeters, voltmeters, station transformers, in fact all the requirements of a modern switchboard down to a time clock.

The board presents a very handsome appearance, and the wiring and method of changing circuits is exceedingly simple, it being practically impossible to make a wrong connection. The value of this type of switchboard to a central station may be realized from a detailed description. The dynamo circuit is connected to a primary fuse box which is of new design and capable of withstanding 150 amperes at 2,200 volts. This fuse box is constructed in such a manner that the gas generated by the blowing of the fuse ruptures the arc. The other terminal of the fuse box is arranged to be connected with the feeder board with a double-pole single throw switch, which is also of improved design. These connections are made through a set of bus bars arranged to be connected with plugs as shown, and put in circuit with the feeders by a double-pole double-throw switch. The arrangements of plugs and connections is such that during the act of transfer there is no current at the terminals. By the system of plugs arranged any dynamo can be thrown on any feeder, it being absolutely impossible to multiple-arc the circuits.

The board is also equipped with a new style ground detector which is exceedingly handsome in appearance, and is, at the same time, so sensitive that the slightest ground is detected and brought to the attendant's notice. The transformer is also of new and improved design. Another novelty is the adoption of a standard voltmeter, so arranged and connected as to be connected with any dynamo in the station. This method guarantees that the voltage of the dynamo will be the same, and effectually obviates the errors due to different readings of several instruments effected, as they so often are by external magnetism. The illustration given is from a photograpph taken while the board was at the factory.

A Large Switch.

The illustration shows a new switch manufactured by the W. S. Hill Electric Company, Boston, Mass., for railway and central stations. For the past year these switches have been in use in very large numbers, one power station alone having over 300 in use of from 500 to 4,000 amperes capacity. The improvements consist in broadening the



4000 AMPERE SWITCH.

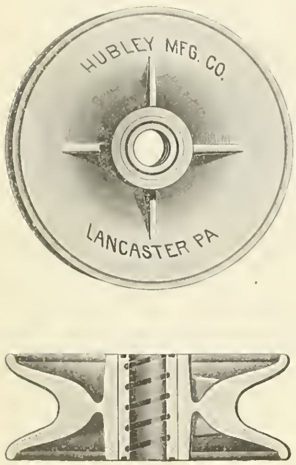
ends of the blades and yoke so as to admit of using two bolts, thus uniting the two so firmly as to prevent all twisting or straining of the parts while the switch is being operated. The method of backing up

the flexible brush contacts by plates of pure copper, practically converts the blade and contact into one continuous piece of metal, and as the size of all the carrying parts are computed at 1,000 circular mils per ampere, it will be seen that the area is amply sufficient.

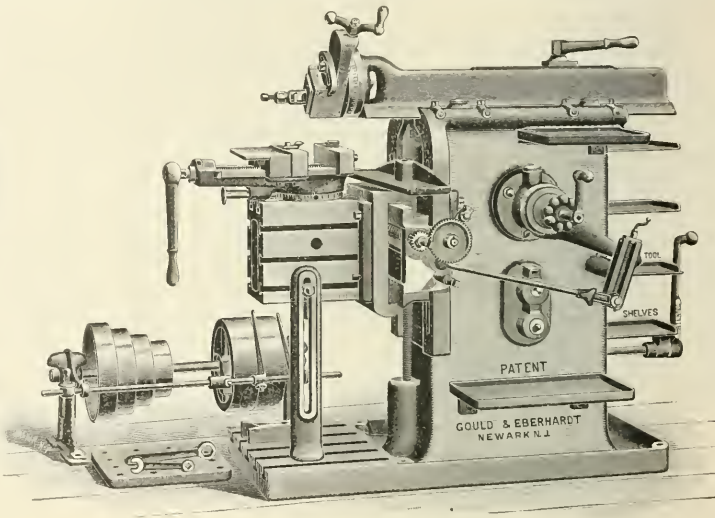
An Improved Shaper.

The accompanying illustration represents a new shaper brought out by Gould & Eberhardt, Newark, N. J. It is operated by an improved crank motion and is positive in length of stroke and will plane to a line, which is essential where accurate results are required, as in die work, etc. This motion also gives an unusually quick return stroke, by which, on short work, double the usual number of strokes can be obtained. All bearings are large and long, especially the bearing of the ram in the frame. Indexes are provided to tell the workman the length of stroke for which the machine is set at any position of the ram, also for changes of feed, which are made by means of screw and crank. Work can be fastened in a variety of ways, for which provision is made. The vise swivels and is graduated to set at any angle and can also be fastened to the side of the angle.

By removing the angle, work can be fastened to this part direct. A surface plate also permits work to be done which is otherwise impossible. The rise is provided with a pair of adjustable centres, for planing small work, fluting reamers, taps, etc., and a pair of special jaws for holding taper work. An improvement especially noticeable on this shaper is the extension base which, besides giving a large foundation to the machine, acts as a support to the work table, thus increasing the accuracy of the work when taking heavy cuts. The design of the base is such as to form a pan around the machine to catch oil drippings, etc., and thus preserve a neat appearance to the floor around the machine.



New Trolley Wheel.



An Improved Shaper.

New Trolley Harp and Wheel.

Among several new specialties of the Hubley Manufacturing Company, Lancaster, Pa., is a new trolley harp and wheel, illustrated herewith. The trolley wheel, a section of which is shown in the cut, has its edge protected by a bead, to give it greater strength and prevent it from cutting and otherwise injuring the overhead fixtures or wire. The wheels are designed to give a long service, and are made of special high grade bearing bronze, and, as will be seen by referring to the cut, the metal is placed in the direction of the wear. The spokes are similar to those used on the other high grade wheels, and will not allow the edge to drop off in case it should be worn through. The hub has a large diameter, a good contact with the springs, and is fitted with the best anti-friction bushings. In the harps are combined the two essential qualities of lightness and strength. They are made of the best malleable iron and high grade bronze, both having steel shanks. The sides are made with a crescent section and offer a rounded surface to prevent catching or cutting the overhead fixtures, which gives also a handsome appearance.

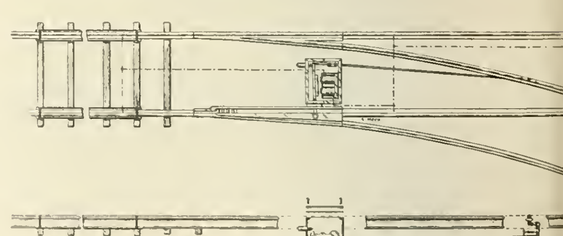
The Canal Tugboat.

In the article by Mr. F. M. F. Cazin under the above caption in our issue dated October 6, there is a typographical error in the 13th line from the bottom of the second column on page 345. In the equation for P_1, expressed in kilogrammes-metres, the term $\frac{V^2}{2}$ should be $\frac{V^2}{2g}$

A New Track Switch.

The accompanying cut illustrates an automatic electric traction switch which has recently been patented by Messrs. Walter V. and Joseph H. Ash, of Newark, N. J. The device consists of an ordinary tongue switch of such dimension that it can be set in place of a regular tongue switch without alteration of the track. The tongue is operated by two electro-magnets, which are placed horizontally in a water tight iron casing bolted to the side of the switch between the tracks. The electro-magnets actuate an armature, which is connected by means of a short vertical shaft, extending, at its upper end, under the heel of the tongue to which it is rigidly keyed.

The terminals of the windings of the electro-magnets are connected to the bonded rails and a pair of insulated rails respectively, being excited by the current from the motor car while in motion. The operation of the switch is as follows: The main line being always open, as soon as the car which is to leave the main line runs on the insulated rails with a small current on its motors, its current will excite the magnets by passing from the insulated rails through their winding to the bonded rails beyond; the magnets will instantly attract the armature, which, being connected rigidly to the tongue, will throw it over, thus opening the switch. This is locked in position by a self-acting latch, which is released by the car passing over the tripping device placed in the head of the rail beyond the switch. The cars bound for the main line will of course have to drift over the insulated rails without current on their motors. Under the point of the tongue the switch is perforated to allow stones, dirt, snow, etc., to drop into a box beneath which is connected with the sewer, making it self-cleaning. The switch which has been in operation on the lines of the Consolidated Traction Company,



Automatic Track Switch.

Newark, N. J., cor. Bridge and Broad streets, since Sept. 17, is reported as giving excellent satisfaction to the officials of the Traction Company. The switch was constructed and tested in the shops of the Stucky & Heck Electrical Manufacturing Company, No. 35 New Jersey Railroad avenue, Newark, N. J. They will be placed on the market by the Ash Automatic Electric Switch Company, of which Mr. Jos. Samuel is president and Walter V. Ash, general manager.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 20, 1894.

ELECTRICAL STOCKS attained unusual prominence during the financial week ending to-day, but for the most part it has been secured at the expense of quotations, all the activity having been on the bear side. The managers of the various big electrical manufacturing companies still persist in declaring that business is much improved, but there are many who want to know where any profit comes in when car equipments, for instance, sell for $650 per car or even less, and it is due to the currency of such doubts as to any ability to earn money that has led to the recent onslaughts against the stocks of the electrical companies.

GENERAL ELECTRIC, as usual under such circumstances, has been the chief target of the bear clique and they have been as reckless as ever in promoting all kinds of stories detrimental to the company's standing. That the bears have been as successful as the record of the week's transactions evidence is due, however, more to the lack of support from the Company's friends than to any general belief in the bears' tales. The operators on the down tack make the point—admittedly supplied them by the Company's competitors—that General Electric is selling its products at prices 50 per cent. below those current a year ago and that it is pursuing its old methods of getting business at any cost, now, however, merely cutting prices, where formerly it made concessions in the manner and time of payments. The chief cause of the week's decline is more due to the great abundance of stock and its consequent easy manipulation than to the genuineness of the bear stories. The Company's officials aver that its works are running practically full time and full force on a cash basis. The volume of gross business, considering the times, is very satisfactory, being considerably larger than it was a year ago and about 70 per cent. of the normal. Net returns are also fairly good and there is declared to be absolutely no truth in the reports that business is being taken at a loss. As to its financial condition, General Electric now has about $500,000 cash in its treasury, has no floating indebtedness and has in the last two months redeemed and cancelled $700-000 of its debenture bonds. What, however, must militate against any decided improvement in the stock's quotation is the uncertainty still attending the correction of the odd $12,000,000 capital impairment.

WESTINGHOUSE ELECTRIC issues have remained stationary. There is hardly enough of these shares floating around to admit of much speculation, but there is always sufficient doing to furnish an index as to current conditions. Boston gossip has it that a common stock dividend could be paid without putting the Westinghouse Company's resources to any unusual strain. There has been some unusual expense in the new buildings, but the economies in operation promised will pay for them in a short time. From Pittsburg comes what purports to be official information to the effect that the company has in hand more and larger orders than ever before in its history, and all taken on a practically cash basis; that its present works are so over-crowded that the operatives have hardly elbow room; that the works are going day and night; that, while the new plant at Brinton is being pushed to completion as rapidly as possible, it will be some time before the Company will be able to occupy the works; that the new glass factory in Allegheny for the manufacture of electric light bulbs, to be occupied Nov. 15, will be the largest works of the kind in the country. Knowledge of all these facts is probably at the bottom of the current strength and even advance of Westinghouse issues.

AMERICAN BELL TELEPHONE is again down. While selling has been limited the demand is poorer and the stock continues to slump. It comes from authentic sources that the Company will soon issue 10,000 shares ($1,000,000) new stock, and the selling is attributed to this cause, the argument being that investment holdings now let go can be replaced at a lower price either at the auction sale or in open market. The company is understood to be organizing a syndicate to underwrite the first auction sale at 190. The income of the company continues satisfactory. The Long Distance Company continues to pay its 5 per cent. dividends to the Bell company, while the New England and some other subsidiary companies are increasing the dividend payment.

THE ERIE TELEGRAPH AND TELEPHONE people, since the stock was listed in New York, are trying to give it prominence by furnishing on different occasions figures as to business and earnings. Net earnings for July and August are reported as being $66,637, an increase of $4,559. For the three months ending September 30, there was a net gain of 252 exchange subscribers, the total being 14,667. The total of subscribers connected on Sept. 30 was 15,780. The stock is off 2 points in the price bid.

WESTERN UNION continues to be sold down, the directors all the time putting out statements that "the decline, in view of the excellent showing of the annual report, is inexplicable." Nothing new develops as to the company's condition, business continues satisfactory and the decline is apparently purely a speculative movement. There are hints of inside selling, but no justification of the rumors are offered.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES furnishes some interesting figures for its first year of operation. The company bought from the General Electric Company $12,188,266 in securities and received from other companies against advances, etc., $683,517, amounting in all to $12,871,784. Of this sum $2,472,229 of securities at par value have been disposed of, leaving $10,399,555 now held by the trustees. The company has received from the sale of various securities $1,314,155, and has paid $1,250,170 for 13,561 shares of preferred stock. The balance from the sale of securities was expended in advances to various companies and in purchase of additional securities. There was $238,-957 received as interest, of which $168,242 was paid in dividends on preferred shares and $57,088 in expenses of trust, leaving a balance of $13,627

BROOKLYN EDISON ELECTRIC ILLUMINATING stock is somewhat higher by reason of the scarcity of the security in the market, and the continued good business of the company. The stock is now quoted at 109, which is 7 points higher than the stock of the New York Illuminating Company.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	101½	102½
" " " Brooklyn	100	109	110
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	35½	36
General Electric pref	100	65	70
Interior Conduit & Ins. Co.	100	25	35
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35½	36
* " " pref	50	52½	53½

BONDS.

	Par.	Bid.	Asked
*Edison Electric Ill., New York	1,000	107½	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	88	90

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
*American Bell Telephone	100	198½	199½
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	101½	105
*Commercial Cables	100	125	145
Erie Telephone	100	54	56
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
New England Telephone	100	67	69
Postal Telegraph-Cable	100	54	60
*Western Union Telegraph	100	88	89

* Ex-div.

NEW INCORPORATIONS.

THE IRONTON STREET RAILROAD, LIGHT & POWER COMPANY, Ironton, Ohio, capital stock $100,000, has been incorporated.

THE NORTH SHORE ELECTRIC ROAD, Chicago, Ill., capital stock $10,-000,000, has been formed by J. L. Cochran, D. H. Louderback and Dunlap Smith.

THE JAMESTOWN & LAKE ERIE RAILWAY COMPANY, Albany, N. Y., capital stock $250,000, has been incorporated. The road will skirt the shores of Chautauqua Lake.

THE CLIFTON PARK PASSENGER RAILWAY COMPANY, Baltimore, Md., capital stock $50,000, has been chartered and will erect a power plant to operate its proposed street railway.

THE PITTSBURG TROLLEY POLE COMPANY, Pittsburg, Pa., capital stock $5,000, has been incorporated by John D. Biggert, R. S. Robb and Sam R. Wilson, to manufacture iron or steel or both.

THE SUMMIT IMPROVEMENT COMPANY, Summit, N. J., capital stock $30,000, has been formed to generate and supply electricity. William Halls, Jr., Chas. E. Kimball and Thos. F. White, of Summit, are interested.

THE LAKE SHORE ELECTRIC RAILWAY COMPANY has been incorporated with a capital stock of $10,000,000. This line will run from Chicago to Milwaukee, and will be equipped with the latest and best machinery.

THE ANTO-ELECTRIC COMPANY, Grand Rapids, Mich., capital stock $15,-000, has been formed to manufacture and sell electrical apparatus. Fred C. Norris, Lansing; E. F. Sweet and W. S. Burnett, Grand Rapids, Mich.

THE DUNDEE ELECTRIC LIGTH COMPANY, Dundee, Mich., capital stock $12,000, has been formed to generate and sell electricity. Cora Watkins, Ida Avis, George T. Avis and D. H. Chapman, of Hudson, Mich., are interested.

THE DAUPHIN LIGHT, HEAT & POWER COMPANY, Harrisburg, Pa., capital stock $50,000, has been incorporated to supply light, heat and power by electricity. Joseph Pyne, Mercer R. Tate and J. Grant Koons are interested.

THE WHITTINGHAM ELECTRIC CAR HEATING COMPANY, Baltimore, Md., maximum capital stock $100,000, has been formed to manufacture, sell, etc., heating or other apparatus, and generally for the purpose of dealing in such.

CAPE GIRARDEAU WATER WORKS & ELECTRIC LIGHT COMPANY, Cape Girardeau, Mo., capital stock $100,000, has been formed to operate a light and water plant. Leon J. Albert, David A. Glenn and R. E. Gannon, Cape Girardeau, Mo.

THE CHICAGO CENTRAL ELECTRIC RAILROAD COMPANY, Chicago, Ill., capital stock $1,200,000, has been incorporated to construct and operate street railroads. George W. Waterman, Wm. R. Odell and Charles A. Boos are interested.

THE EASTERN TRAMWAY CONSTRUCTION COMPANY, Jersey City, N. J., capital stock $2,000, has been formed to construct and equip electric railways. Howard Ellis, Ridgewood, N. J.; John E. Bowles and George H. Wright, New York, are interested.

THE IRONTON STREET RAILROAD, LIGHT & POWER COMPANY, Ironton, Ohio, capital stock $100,000, has been formed to operate a street railroad and furnish light and power. H. A. Marting, Leo Ebert and R. Mather are the interested parties.

THE NEW ATHENS ELECTRIC LIGHT & POWER COMPANY, New Athens, Ill., capital stock $4,500 has been incorporated to furnish New Athens with electric light, heat and power. Isfried Probst, Paul Lehman and Frank Fenerbacher are interested.

THE WILLIAMS VALLEY STREET RAILWAY COMPANY, Girardville, Pa., capital stock $100,000, has been formed to construct, maintain and operate an electric railway. Charles A. Barnhard, Moses Mervine and George C. Hachel, Girardville, Pa., are interested.

THE HOME TELEPHONE COMPANY, Uniontown, Pa., capital stock $6,000, has been incorporated by Wm. C. McCormick, Albert Inks and O. J. Sturgis, to

struct and operate a telephone line from Uniontown, Fayette county, to Scottdale, Westmoreland county, Pa.

THE ELECTRIC MESSENGER COMPANY, Pittsburg, Pa., capital stock $20,000, has been incorporated to build and maintain telegraph and telephone lines and exchanges. W. S. Miller, J. N. Pew, Pittsburg; W. T. Marshall, Allegheney, City, Pa. are the incorporators.

THE KEY WEST LIGHT & POWER COMPANY, Key West., Fla., capital stock $125,000, has been incorporated to operate an electric light plant. The promoters are John J. Philbrick, president; George W. Allen, secretary, and Joseph S. Whalton, Jr., treasurer.

THE KANSAS CITY TRACTION COMPANY, Kansas City, Kan., capital stock $1,000,000, has been formed, to acquire, construct and maintain a street railway. B. S Coler, Brooklyn, N. Y., and Wm. J. Smith and Wm. H. Lucas, Kansas City, Mo., are the interested parties.

THE GRAFTON ELECTRIC COMPANY, Grafton, Mass., capital stock $10,000, has been formed to generate, sell and distribute electricity for light, heat and power. Clarence R. Pratt, Clarence McClelland, George W. Fisher, Charles L. Pratt and Charles H. Miles are interested.

THE WAYNE ELECTRIC LIGHT STEAM & HEAT COMPANY, Wayne, Pa. minimum capital stock $1,000, has been incorporated to supply light, heat and power by means of electricity. Herman Wendell, Frank Smith, Wayne, and W. B. Smith, Philadelphia, Pa., are the promoters.

THE ASH AUTOMATIC ELECTRIC SWITCH COMPANY, Newark, N. J., capital stock $250,000, has been formed to manufacture and sell automatic electric traction switches, etc. Joseph Samuel, Walter Voorhis Ash, Joseph Hardy Ash and Moses Hirsch, Newark, N. J., are interested.

THE BETHLEHEM & NAZARETH ELECTRIC STREET RAILWAY COMPANY, Bethlehem, Pa., capital stock $100,000, has been formed to construct, maintain and operate an electric street railway. Ashton C. Borhek, Albert Broadhead and Abraham Schropp, Bethlehem, Pa. are the promoters.

THE EAST LIVERPOOL TELEPHONE ELECTRIC COMPANY, East Liverpool, Ohio, capital stock $10,000, has been incorporated to construct and operate a telephone system, and to furnish electric light and power, etc. James C. Diedrick, T. A. Corcoran and G. W. Meredith are the promoters.

THE IMPERIAL ELECTRIC BELL & FIRE ALARM MANUFACTURING COMPANY, Huntington, W. Va., has been incorporated to manufacture W. J. Schweiger's patent electric bell and fire alarm apparatus, etc. James K. Oney, E. B. Enslow and C. E. Gwinn, all of Huntington, are interested.

THE AKRON, BEDFORD & CLEVELAND RAILROAD COMPANY, Akron, Ohio, capital stock $300,000, has been formed to construct and operate an electric railroad, and to generate electricity for light, heat and power, etc. John F. Sieberling, F. A. Sieberling and Jas. Christy, Jr., are the promoters.

THE PEEKSKILL & CORTLANDT ELECTRIC RAILWAY COMPANY, Peekskill, N. Y., capital stock $150,000, has been incorporated to build and operate a road four miles long in Cortlandt, Yorktown and Peekskill. Edgar Peckham, Benjamin Norton, New York City, and H. C. Soap, of Kingston, are interested.

THE CITIZENS' STREET RAILWAY COMPANY OF BATTLE CREEK, Battle Creek, Mich., capital stock $100,000, has been formed to construct and operate a street railway, and to furnish electric light and power. Loren N. Downs, New York City; Hale P. Kauffer and T. N. Rowley, Kalamazoo, Mich., are all interested.

THE WESTLAKE ELECTRICAL MANUFACTURING COMPANY, East St. Louis, Ill., capital stock $100,000, has been incorporated to own and control patents and to manufacture the appliances appertaining thereto; also a general manufacturing business. Chas. T. Westlake, David Biggs, Edw. Sells and Charles Cummings Collins are the incorporators.

THE SINOLOA ELECTRIC LIGHT & POWER COMPANY, Des Moines, Iowa, capital stock $20,000, has been formed to establish an electric light and power plant in the city of Guliacan, Sinoloa, Mexico. Warren A. Drake, Clarence S. Brown, Chicago, Ill., Carlos E. S. Covar, Sinoloa, Mex., and C. E. Hunn, Des Moines, Iowa, are the promoters.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, Oct. 22, 1894.

MR. VICTOR R. BROWNING, of the National Carbon Company, Cleveland, O., was in the city last week, and reports that the concentration of the business of the National Carbon Company in Cleveland is completed. With the facilities now possessed notable advances will be made in the manufacture of carbons.

MR. W. J. MORRISON, who has represented the Fort Wayne Electric Company in the State of New York for the past 7 years, has resigned his position, much to the surprise of his numerous acquaintances, as he is known to be one of the greatest hustlers in the business, in consequence of which he acquired the sobriquet of "Hustling Billy." During his connection with the Fort Wayne Company he sold 436 arcs (Wood system) and 36,600 incandescent lights with dynamo capacity to match, representing a total of about $1,400,000 worth of apparatus.

THE OAKMAN ELECTRIC CO., (recently reorganized) has moved its offices from the fifth floor Electrical Exchange, to Room 414, fourth floor, same building. The business of this young company has grown to such an extent that the old quarters had become entirely too small for the increased business. This company is agent for several good specialties, among which may be mentioned the McNut incandescent lamp, Hornberger transformers, New England snap switch and Cutler-Hammer rheostats and automatic motor starting boxes.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, October 20, 1894.

THE WASHBURN & MOEN COMPANY, of Worcester, Mass., has recently sold a large order of insulated wire to the Cincinnati Street Railway Company, of Cincinnati, Ohio, consisting of some 200,000 feet of "Crown" rubber insulated cable of 500,000 cir. mils cross sectional area.

MR. LEONARD HERBERT DES ISLES, superintendent of the Electric Heat Alarm Company, of Boston, was recently united in marriage to Miss Carrie Lynwood Clement, both of Boston. We present our congratulations to the happy couple and best wishes for a life of uninterrupted happiness.

THE BOSTON MOTOR COMPANY, Boston, which make a specialty of small motors, and especially fan motors and batteries combined, at very economical rates, now control the "Jupiter" Storage Battery, as well as the Curtis primary battery. In the direction of small motors and aluminum fans and experimental services this company offers several attractions to the public.

THE W. S. HILL ELECTRIC COMPANY, of Boston, continues to receive large and gratifying orders for its well-known switches and switchboard apparatus, and their establishment is still running to its full capacity. As is well known, this company devotes especial care and attention to the designing and construction of switches and switchboards, both for isolated and central station work, and Mr. Hill himself is recognized as one of the pioneers in electrical work.

THE COLUMBIA ELECTRIC COMPANY, of Worcester, Mass., is pushing forward at quite a rapid rate, and has been compelled to increase considerably its working force. Manager Coghlin reports business as exceptionally good. It has recently received contracts for wiring the Ruddy Block, the Sawyer Block, the Houghton Block and St. Jean Baptist Hall, all located in Worcester, and all large contracts. The Houghton Block is the first building in Worcester to adopt the interior conduit system.

THE BIBBER ELECTRIC MANUFACTURING COMPANY, of Boston, is doing an excellent business in its new gas-lighting appliances in both the Pendant and Key types of apparatus. It would appear that the "Bibber" electric gas-lighting burner and the "Vigilant" pendant burner are being quickly recognized as notable improvements in gas lighting. It is stated that the regulation of the height and flow of the gas are important features, combined with the simplicity and economy of the devices.

THE ATTLEBORO STEAM & ELECTRIC COMPANY, of Attleboro, Mass., whose station was burned last spring, started up their new plant Oct. 1. The contract for rebuilding the entire electrical equipment was given to the Rushmore Dynamo Works, Jersey City. The station furnishes all the street and commercial lights for the city and surrounding towns, and the station is considered one of the finest in the state. The company did a large amount of special lighting for the Bi-Centennial Celebration of the founding of Attleboro, October 18 and 19. The success of the electrical display was completed by two large Rushmore search lamps.

THE THOMPSON-BROWN ELECTRIC COMPANY, recently organized under the laws of the State of New York, is about to open a store in Boston at No. 97 High street. The incorporators, it is said, include several representative men in the electrical business. Mr. George Thompson, Jr., president, of New York, has been in the electrical railway business for a number of years. Mr. Maybin W. Brown, until lately president of the Brown Electric Company, is treasurer of the new corporation, and has been well known to the fraternity for many years. Mr. Earnest F. Ayrault, of the law firm of Hawksworth & Ayrault, New York, is secretary. Mr. F. E. Pettingell, who is so well known as to require no special mention, will be an element of strength to the new concern. Mr. H. P. Brown, who has been traveling representative of the Brown Electric Company, and is well known on the road in New England, is also identified with this corporation. The Thompson-Brown Electric Company is sole New England agent for The E. S. Greeley & Co., of New York, one of the oldest electrical establishments in existence. This company proposes to have a "house warming" on Thursday afternoon and evening, October 25, to which all their friends are most cordially invited.

Canadian Notes.

Ottawa, Oct. 20, 1894.

MONTREAL.—The extensive use of the bicycle has caused the Montreal Street Railway Co. to consider the advisability of reducing fares to two cents.

VANCOUVER, B.C.—By a majority of ninety-two votes the citizens have decided to borrow $100,000, to erect a civic electric light plant to light the streets and also to supply private consumers.

MONTREAL.—At the recent annual meeting of the Merchant's Telephone Company it was stated that the company has done about three-fourths of the work necessary to put into operation about 800 instruments. This exhausted the capital stock of the company, but the directors subscribed $50,000 more at eight per cent.

MONTREAL.—At the first annual meeting of the shareholders of the Montreal Island Belt Railway Company, it is stated that $550,000, of the $5,000,000 capital stock of the company, has been subscribed, but of this sum $55,000 is paid up. According to a clause in its charter the company cannot begin work until it has deposited $250,000 to its credit in a chartered bank.

OTTAWA, ONT.—A charter has been issued by the Dominion Government incorporating a company consisting of Jacob Dilcher, banker, of Buffalo; James Bampfield, merchants, Niagara Falls; James Cleary, broker, Troy; Henry Steivert and John Harrington, New York, with power to operate offices for the purpose of communicating by telephone and telegraph. The name of the company is The Colonial Telegraph and Telephone Company, with a total capital stock of twenty-five thousand dollars.

QUEBEC.—Official notice is given that application will be made to the provincial legislature, at its next session, by the Hon. Louis Tourville, of Montreal, and others, for an act to incorporate them as the South Shore Electric Company, with power to construct and operate works for producing electricity for light, heat and power, and to construct electric railways in the counties of Vercheres, Chambly and Laprairie, and upon any bridge connecting the said

counties with the north shore of the River St. Lawrence; to acquire and maintain water works in any of the said counties, and to do all such things as may be necessary or incidental to any of the said objects.

TORONTO.—The Fire and Light Committee has decided to recommend the Council to accept the tender of the Toronto Electric Light Company, for lighting the streets at the rate of \$72.82½ per light per annum. Chairman Stewart announced that, according to tenders received and the estimate of the City Engineer, the annual charges of a municipal electric lighting plant would be \$100,595. Allowing four per cent. for interest and six per cent. for depreciation, which amounts to \$25,300, and putting the running and maintenance expenses down at \$75,295, counting 1,300 lights, the cost of each light per year would come to \$77.37 or \$2.55 per light more than the tender of the Toronto Electric Light Company.

OTTAWA, ONT.—The amalgamation of the Standard Electric Light Company and the Chaudiere Electric Light Company of this city, under the name of the Ottawa Electric Light Company, has brought about a complete reorganization of the directors and staff. The officers of the company are: President and general manager, T. Ahearn; secretary-treasurer, G. S. McFarlane (formerly with the Standard Company); general superintendent, A. A. Dion (Chaudiere Company); chief accountant, D. R. Street (Chaudiere Company). The company now possesses five power-houses, four of which are water power and one steam power. The combined capacity of the dynamos now in position is 35,000 incandescent lights, and 500 arc lights. The steam plant is only used occasionally, and is particularly in demand during the anchor-ice period in the fall and spring.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, October 10, 1894.

ELECTRIC COAL CUTTING.—A new colliery will shortly be opened in the midlands, under American management, and it is announced that it will be electrically worked throughout. Hitherto, owing to the disinclination of managers to make proper arrangements for carting away the coal cut, and the natural dislike of the men to be superceded by machinery, the electric coal cutter has not had fair play in England. Now that several new collieries are being opened up, it may therefore be hoped that electricity will be adopted from the start, and will be allowed to show what it really can do if it is allowed to do all it can.

ELECTRICAL UTILIZATION OF WATER POWER.—To-morrow the Worcester Municipal Electric Lighting Station will come into operation. This station is interesting as being the first of its kind, that is to say, the first station of any size in which water power has been utilized. For England, the city of Worcester is peculiarly favorably situated in respect to water power. This, however, is the result of trying to use English water power. The Town Council has been obliged to erect its station some three miles outside the city and to construct large storage works, etc. Yet the drought in summe, and the floods in winter necessitate that the turbines should be supplemented by an equal steam plant. It is therefore obvious that very little can have actually been gained by making use of the water at all. Another point of interest in the Worcester station is the fact that the mains from the power house to the town are on the Brooks oil system.

A BIG BREAK-DOWN OF THE CITY ELECTRIC LIGHTING.—The city was visited yesterday by a fine specimen of the London fog from sunrise to sunset, with the result that the City of London Electric Lighting Company probably had the heaviest and most continuous load that it has as yet had to cope with. A viciously inclined exciter switchboard took a mean advantage of this circumstance to make earth, with the result that the field of two alternators was short circuited, with the further result that the remaining machines of the station proceeded to pump heavy currents into the armatures. In order to ascertain the exact extent of the damage done, and to prevent a recurrence of this untoward mishap, the entire station was shut down for some thirty minutes at the busiest hour of the day and some 60,000 to 80,000 lamps were extinguished. I do not know whether busy city men will be mollified on learning that the switchboard in question was only a temporary contrivance. It is needless to say that the gas companies rejoice greatly.

TELEPHONE RECEIVERS IN THE LAW COURTS.—It is generally expected in legal circles that the term of office of the new Lord Chief Justice will be marked by many useful innovations calculated to startle the ultra-conservative legal mind. The first innovation of the Lord Chief Justice, which has been made public, is certainly one calculated to fix attention. Three telephone receivers are to be fitted in the Lord Chief Justice's court, one on the bench, one at the bar, and one near the witness box, with a view of enabling eminent solicitors and eminent counsel to give at least oral attention to the various cases in which they happen to be simultaneously concerned. The multiplicity of cases which a fashionable counsel considers it compatible with the interests of his clients to take up at one time, has long been a source of just complaint among litigants, who complain that instead of securing the entire services of the aforesaid fahionable counsel, they frequently only get a fraction. It would seem as if the innovation of the Lord Chief Justice would still further reduce the numerator of this fraction.

THE BOARD OF TRADE ELECTRICAL STANDARDIZING LABORATORY.—After a long delay the Electrical Standardizing Laboratory of the Board of Trade may be said to have come into operation. It is externally a very humble concern, and internally extremely small. The laboratory consists of six rooms in the basement of an old house, close to the Houses of Parliament, belonging to the Board of Trade. One room is occupied by a gas engine and the dynamo which charges the secondary batteries, from which all the necessary power is derived. Another room is occupied by the batteries themselves. The third room contains the standards of current and pressure. The fourth room contains the transformer machines for converting the low pressure continuous current from the accumulators into high pressure continuous or alternating currents as may be desired. The fifth room contains the standard of resistance, and is devoted to electro-motive forces. The last room is devoted to the verification of commercial instruments of all kinds. The accumulators in use consist of a battery of four large Crompton-Howell cells, which are used two in parallel for the direct production of large currents, and a battery of 108 E. P. S. cells. The large cells can supply current of 2,000 amperes for a short time. In the room containing the standards of current and pressure there are arranged on a slate shelf five magnificent "Kelvin" balances capable of measuring currents from 1 ampere up to 2,500 amperes. The standard current balance is an elaborate structure placed on a stone pedestal in the centre of the room. It consists of a sensitive balance suitable for the weights up to five kilograms, with beam arms 16″ in length, from which scale pans are hung. Under the end of one arm there is a hollow cylinder of white statuary marble, on the outside of which two circular grooves are cut near the top and near the bottom. Into these groves two coils are wound. Each coil consists of 16 turns of No. 18 S. W. G. wire per layer, and there are 16 layers in each coil. A circular coil is suspended inside the cylinder from one end of the beam arm by means of three gilded wires .086 cent. diameter. Connection is made with the supended coil in the following manner. The ends of the coil are brought out near each other and a considerabe length of wire is allowed for each end, and is formed into a spiral, and then projected horizontally into the centre of the coil where are situated the terminals of the leading-in wires, the wires from the coil being connected to this terminal by fine flexibles. The transforming machinery consists of a continuous current motor and an alternator with shafts in line and both keyed to the same pulley. The batteries supply current to the continuous current motor, and the alternator can be made by means of various transformers to supply currents up to 500 amperes, and pressures up to 10,000 volts. The motor can also be made to drive a continuous current high-pressure dynamo. It is needless to add that all the rooms containing standards are kept at a constant temperature.

News of the Week.

TELEGRAPH AND TELEPHONE.

ASHEVILLE, N. C.—Address J. M. Ingle with prices of telephone supplies.

ROCK HILL, S. C.—Address A. R. Smith concerning contemplated erection of a telephone exchange and line.

SALISBURY, MD.—The Wicomico Falls Milling and Electric Company wants information in regard to telephones for a local exchange.

CEDAR RAPIDS, IOWA.—The Cedar Rapids Telephone Company was recently granted a twenty-five year franchise by the City Council.

WILSONVILLE, ALA.—J. C. Jackson & Sons are in the market for telephone supplies, and desire estimates of cost of telephone systems for line six miles long.

WHEELING, W. VA.—The City Council of Wheeling has passed resolutions compelling telephone and telegraph companies to place their wires underground.

POYSIPPI, WIS.—The Badger Telephone Company was organized with a capital stock of \$2,000. A telephone line between this place and Berlin will be built and the new company will then control a direct line from Berlin to Waupaca, with several short branches. The officers of the new company are H. A. McWain, president; V. A. Barr, treasurer; John Boysen, secretary.

SCOTTSBURG, IND.—The citizens have incorporated a telephone company, and within forty days the town will be in communication with Lexington, Ind. Madison and the Falls cities, and will have connection by long distance telephone with Indianapolis, Cincinnati and Chicago. Ezra Thomas is president, and George V. Cain secretary.

ELECTRIC LIGHT AND POWER.

ATHENS, MICH.—The subject of electric lights is being agitated.

BARNET, VT.—An electric light company has been organized here.

CRESTLINE, OHIO.—Crestline has voted not to establish an electric light plant.

JACKSONVILLE, ALA.—The Jacksonville Oil Mill Company will buy an electric light plant.

RICHMOND, VA.—The city is considering the question of constructing its own electric light plant.

SHELBYVILLE, IND.—Frank L. Nukolls has been appointed receiver for the Indiana Water & Light Company.

DULUTH, MINN.—Two hundred citizens of Duluth Heights have signed a petition asking for electric lights.

SUMMIT, N. J.—The Town Committee is considering the question of granting a franchise to light the city by electicity.

PITTSBURG, PA.—Fire damaged the electric light station of the Allegheny County Light Company to the extent of \$30,000.

GERMANTOWN, O.—An ordinance is before the Council to provide for the issue of \$8,000 in bonds for an electric light plant.

WAUPACA, WIS.—The Waupaca Common Council has granted a twenty years' franchise to the Waupaca Electric Light Company.

ANAHEIM, CAL.—An election will be held on Oct. 27th to decide whether or not the city will issue bonds for an electic light plant.

APALACHICOLA, FLA.—The City Council is considering the erection of electric light plant and water works. Address the Mayor.

ST. PETESBURG, FLA.—The Williams Ice Company, St. Petersburg, Fla., wants estimates on a 500 incandescent electric light plant, complete.

MARION, OHIO.—The stockholders of the Marion Electric Light and Power Company have voted to increase the capital stock from \$40,000 to \$100,000.

TREMONT, PA.—The electric light plant will be ready for operation about November 15. The Mansion House is being converted into a power-house.

CHICAGO, ILL.—The Mutual Electric Light Power Company has been granted a permit to erect a power house on 89th street. This power house is to cost \$70,000.

LYNCHBURG, VA.—The City Council has decided, by a vote of eight to seven to appopriate \$60,000 in bonds for the erection of an electric light plant. Address the Mayor.

PALATKA, FLA.—The Palatka Light, Power & Supply Company, Box 207, Palaka, Fla., will need one or two 25-kw dynamos, 110-volt lamps, wire insulators, arc lamps, etc.

WYTHEVILLE, VA.—The town owns a municipal light plant which has not sufficient capacity to furnish all the needed lights. Frank Owens is chairman of the Light Committee.

TORONTA, CANADA.—At the meeting of the Parks and Gardens Committee it was decided to recommend the purchase of an electric light plant for the Island at a cost of $1,275.

BUFFALO, N. Y.—A new building is to be erected at the southwest corner of Elliott and Carroll streets, Wells, Williamson & Co., owners. The building is to have an electric plant.

NORFOLK, NEB.—At the general election the city council will vote on a $20,000 bond proposition for the purpose of purchasing the electric light plant and making additions thereto.

KINGSTON, N. Y.—The contract for city lighting has been awarded to Geo. F. Woolston, 40 Wall street, New York. The machinery for this plant will be purchased from the Wall street office.

HULL, MASS.—The town has purchased the plant and franchise of the Hull Electric Lighting Company, and taken possession of the property. The town bonds to pay for the same have been floated.

JACKSONVILLE, FLA.—The contract for the city's own electric light plant was awarded to the General Electric Company, of Atlanta. The plant complete will be put in by this company, and cost $72,850.

BOSTON, MASS.—The Everett Aldermen appointed Aldermen Dyer, Cate and Jennings members of a joint special committee to investigate the report on the feasibility of establishing a municipal electric light plant.

LAWRENCEBURG, KY.—A stock company will be organized for the purpose of establishing an electric light plant, same to be in operation in about a month. G. L. Hogan, of Chicago, Ill., is at the head of the project.

KEY WEST, FLA.—The Key West Light & Power Company has been incorporated, with a capital stock of $125,000, its purpose being to operate an electric plant. John J. Philbrick is president, Geo. W. Allen, secretary, and Jos. C. Whalton, Jr., treasurer.

SACRAMENTO, CAL.—The Sacremento Power & Light Company has closed a contract with the General Electric Company for an equipment to transmit electricity generated by a water power at Folsom, 20 miles distant, for the purpose o supplying light, heat and power to Sacramento.

ALTON, ILL.—The electric lighting company and street railway company have consolidated. Powerful machinery is soon to be placed in the new plant, and within six weeks electric power, as well as light, will be furnished to all who desire it. George Beck is superintendent.

ABBEVILLE, S. C.—A charter has been issued to the Abbeville Light, Water & Power Company, with a capital stock of $30,000, its purpose being to supply the city with light and water. The incorporators are J. S. Cothray, P. Posenberg, W. C. McGowan, G. A. Visanska and others.

EVERETT, MASS.—Aldermen Dyer, Cate and Jennings have been appointed on the part of the upper board, to join with a committee from the lower board, to inquire into the cost of erecting a lighting plant; also to find the price that the Malden Electric Company will ask for their lines.

ANN HARBOR, MICH.—Sealed proposals will be received at the City Clerk's office, Dec. 1st, 1894, for lighting the streets of the city of Ann Arbor with 91 arc lights of 2,000 candle power, to run from sundown to 12.30 a. m., on Philadelphia schedule of moonlight lighting, contracts to run for one year. W. J. Miller is City Clerk.

TERRE HAUTE, IND.—The time for receiving bids has been extended. Sealed proposals will be received by the Common Council until November 6, for lighting the city with electricity according to plans and specifications on file in the office of the said City Clerk. The number of lights now used is 360. Bids will be received for one, three and five years. Charles H. Goodwin, City Clerk.

The Electric Railway.

NATICK, MASS.—The Natick & Cochituate Street Railway Company will extend its line to Natick.

MALDEN, MASS.—The Malden Electric Co. desires to increase its capital stock from $150,000 to $250,000.

ATCHISON, KAS. Topeka and St. Joseph capitalists propose to build a trolley road between Atchison and St. Joseph.

BAR MILLS, ME.—An electric road from Bar Mills to West Buxton is an assured thing, say the citizens of that section.

ST. AUGUSTINE, FLA.—The St. Augustine Electric Railway Company has secured a franchise for constructing its road.

BOSTON.—The West End Street Railway has been forbidden to carry freight on its cars in this city by the Board of Aldermen.

CARTERVILLE, MO.—Chicago parties, represented by Frederick Fitch, propose building an electric railway from Carterville to Carthage.

INDIANAPOLIS, IND.—The Broad Ripple Rapid Transit Company has decided to build a new power-house at Broad Ripple in the spring.

CINCINNATI, O.—The Board of Aldermen has being petitioned for a franchise for extension of the lines of the Consolidated Railway Company.

DELAVAN, WIS.—The Delavan Electric Lighting & Railway Company is seeking a franchise for an electric road. E. J. Brundage is interested in the project.

EAST SYRACUSE, N. Y.—The Syracuse & East Side Railway Company has drawn plans for a large power-house at East Syracuse, to be completed by December 1.

NASHVILLE, TENN.—The Nashville Traction Company will make extensive improvements to its nine and a half miles of street railway, including new 60-p[illegible]ails.

BALTIMORE, MD.—The Clifton Park Passenger Railway Company, just chartered, with a capital stock of $50,000, will erect a power plant to operate its proposed street railway.

NEWARK, N. J.—At the meeting of the Clinton Township Committee the franchise asked by the Consolidated Traction Co. for Freelinghuysen and Clinton avenues was granted.

MONROE, MICH.—President Gardner, of Toledo, Monroe & Detroit Electric Railway, says that the necessary bonds have been placed, and that work on the new road will shortly begin.

SOMERVILLE, N. J.—The New York & Philadelphia Traction Company has abandoned for the present the proposed plan of building a trolley road between this place and New Brunswick.

CINCINNATI, OHIO.—Bert Baldwin has prepared plans for the erection of a power-house at Langland and Knowlton avenues, to cost $200,000, for the Cincinnati Street Railway Company.

MILTON, MASS.—There was unanimous opposition shown by the citizens to the granting of the petition of the Milton & Boston Street Railway Company for a location in the streets of the town.

WORCESTER, MASS.—A new petition has been received form the Worcester Consolidated Street Railway for permission to lay double track on Belmont street, from Plantation street to the city line.

BATTLE CREEK, MICH.—E. E. Downs, supertendent of the Kalamazoo Electric road has resigned his position and will now construct and manage the Battle Creek line, in which he is financialy interested.

TERRE HAUTE, IND.—The stockholders of the proposed Brazil & Terre Haute Electric Railway will meet this week and elect directors and file papers of incorporation. Considerable stock has been subscribed.

CHICAGO, ILL.—The West Chicago Street Railway Company has obtained a permit to build an electric power house on Western Avenue to cost $120,000 and will also erect a car house on West Madison street which will cost $75,000.

CORTLAND, N. Y.—Surveyors for the electric road have been working between McCrawville and Cortland the past week, for the purpose of determining the most feasible route for the company to reach the former place.

ATLANTA, GA.—The Cotton States and International Exposition has closed a contract with parties who will build an intramural railway to be operated by electricity. It will reach every part of the grounds and will run around the lake.

ELLENVILLE, N. Y.—An Ellenville capitalist is enthusiastic over the project to increase the corporation boundaries of the village so as to take in Napanoch, and an electric railroad between the two villages is proposed. It could be built for $20,000.

NORFOLK, VA.—The Norfolk & Atlantic City Railway Co., of which Jos. T. Allyn is president, has applied to the City Council for a franchise to build a street railway to be operated by electricity or horse power. It is to run to Sewells Point and Veu del Eau.

NEW YORK CITY, N. Y.—On November 6th the citizens will vote on the question whether the credit of the city shall be bonded to the amount of $50,000,000 towards the building of a new elevated railroad from the Battery to the city line beyond the Harlem.

WATERVILLE, ME.—Concerning the rumored extension of the Waterville & Fairfield Electric Railway a good authority says that nothing definite has been decided upon. Without doubt the road will be built, perhaps this fall, but probably not before next spring.

WEBB CITY, MO.—Messrs. R. A. Johnson, S. Z. Wollower and A. G. Kingsley, of Harrisbug, Pa., who are directors of the Southwest Missouri Electric Railway Company, have returned East after concluding all necessary preliminaries for the extension to Carthage.

TURTLE CREEK, PA.—The borough council met and granted franchises through the borough to two rival street railway companies. The Second Avenue Traction Company is one of the incorporations favored. The ordinance of the Turtle Creek Valley Company was also passed

HAMILTON, ONT.—The Hamilton, Grimsby & Beamsville electric railway went into operation last week under the superintendence of Mr. F. E. Handy, who also had charge of its construction. The road is now 10½ miles long and when completed will be 28 miles in length.

WAUKESHA, WIS.—A proposition is to be made by the Waukesha Electric Light Company to furnish power for the new Electric Beach Railway Company. The company proposes to put in a 250-hp engine and a dynamo sufficiently large to cover any extenison that may be made in the road.

FRAMINGTON, MASS.—The Framington (Mass.), selectmen voted to grant a franchise to the Natick Electric Street Railway Company for an extension of its tracks to Ashland an Hopkinton. The tracks are already laid from Hopkinton to Ashland. An endeavor will be made to have the road running this fall.

LOCKHAVEN, PA.—A meeting will be held of citizens of Crawford Township, this county, and of Limestone and Bastress Townships, Lycoming county, to discuss the advisability of constructing an electric railway through those townships to Williamsport. Levi Gann, of this city, is one of the enthusiastic supporters of the enterprise.

PORT JERVIS, N. Y.—The Trustees of the village of Port Jervis have voted, six to three, to grant a franchise for building and operating an electric railroad in the streets of that village, to the company allied to one that is to build a road up the Delaware Valley from Stroudsburg. It is very doubtful if the company will accept the franchise on the terms demanded.

FRANKFORD, PA.—The Delaware and Schuylkill Electric Railway Company has awarded the contract for the new trolley line which will connect Frankford and Germantown, and the work is to be pushed to completion. A feature of the construction will be the use of concrete piers or supports in lieu of modern ties, which is an innovation in this country.

CHICAGO, ILL.—Commissiouer Jones has been authorized by the City Law Department to issue the permits asked for by the North and West Chicago Street Railway companies to change a great part of their respective systems from horse to electric power. The applications cover over 100 different streets in all parts of the city. The street car companies expect to get the work under way in about a week.

BEREA, O.—The Cleveland & Berea Street Railway Company is back of a new plan for building an electric railroad connecting Elyria with Cleveland, and the first important step has been taken by L. M. Cor, of Berea, Ohio, who secured a franchise from the county commissioners granting permission for the building of a single track railway, together with necessary side tracks, switches and spurs.

CHICAGO, ILL.—There is a proposition on foot to connect Chicago and Milwauke by an electric railway, and the Lake Shore Electric Railway Company, of Chicago, has been organized for this purpose. John L. Cochran, Clarence Buckingham, Dunlap Smith, D. H. Louderback and Frank P. Hawkins are interested. The capital is $10,000,000. It is understood that the new line will not run into this city, and therefore will not be under the necessity of asking the City Council for franchises.

TOWANDA, PA.—It is now said the people who intend building the electric road in Towanda are satisfied with the conditions imposed by the town council. Mr. C. B. Wells, of the electric company, says he will try and get some stock taken this winter. When spring opens they will go ahead and build the road.

IRONTON, O.—Ironton capitalists have formed an electric light and power company and are contemplating putting in an electric street railroad. The capital is $100,000; and the company will apply for a charter at once.

Miscellaneous Notes.

MR. MAX OSTERBERG, who was graduated from the electrical engineering course of Columbia College this year, has accepted a position as associate editor of "Electric Power" and will also act as one of the instructors in the New York branch of the National School of Electricity.

THE BROOKLYN ELECTRICAL SOCIETY held a regular meeting on Thursday evening, Oct. 18, in the new lecture rooms kindly furnished by the Edison Electric Illuminating Company, at its Central Power Station, 360 Pearl street, Brooklyn. A paper was read by Mr. Thos. A. Bamford, treasurer of the society, on "Telephony Up to Date," illustrated by stereopticon views and apparatus. This is a young society, organized for the diffusion of electrical knowledge, and promises to accomplish a useful end. William Clinton Burling is president, and Arthur A. Fisk, secretary.

THE SPRING GARDEN INSTITUTE, Philadelphia, has prepared a course of forty lessons on electricity which will be taught by Mr. C. W. Swoope on Tuesday and Friday evenings, beginning November 6. Each lecture will last about one hour, and half an hour will then be devoted to giving out problems and answering questions. The following subjects will be taught, and more than half of the time will be devoted to the dynamo and motor and their applications: Electricity, magnetism, galvanic current induction, dynamic current, electric bells, etc., electric lighting, transmission of power, the electric railway, electro-metallurgy, telephone and telegraph, electric heating and modern inventions. The tuition fee will be $5.00 for the course.

THE HENRY ELECTRICAL CLUB, which was the outcome of the course of lectures delivered at Cooper Union last winter in connection with the University Extension, and under the auspicies of Columbia College, has just completed arrangements with the American Institute of the City of New York to become the Electrical Section of the same. Hereafter it will meet every Wednesday evening at the rooms of the Institute, 111-115 West 38th street. The object of the club is to hold informal discussions and have papers on practical subjects presented. In addition, one lecture will be given each month by some specialist on an announced subject. The officers for the ensuing year are: President, W. H. Freedman, E. E.: First Vice-President L. H. Laudy, Ph., D.; Second Vice President, Max Osterberg, E. E.; Secretary, Geoge Whitefield.

THE NIEBUND DEUTSCHER ELEKTROTECHNIKER, of Berlin, has now moved into its new offices at Monbijouplatz, No. 3, and the General Secretary, Mr. Gisbert Kapp, has assumed the management. The question which at the present moment is before the German electrical industry concerns the exhibition to be held next fall at Karlsruhe. This exhibition is intended to bring before the public the advantages of electric power in connection with industries such as are carried on by small concerns or private individuals. For this purpose it is intended to limit the exhibits to tools driven by electromotors and such accessory appliances as may be requisite in the equipment of small workshops with electric power. Hitherto German manufacturers have found electric exhibitions a source of great expense and very little profit, and this experience has resulted in a general disinclination to take part in exhibitions. As, however, an exhibition of the character above described is likely to bring business, the majority of the best firms have decided to take part in it provided they are able, by concerted action, to limit their expenses to reasonable amounts. With a view to attain this result they have agreed to exhibit not individually but through their association.

Trade and Industrial Notes.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, O., has recently added to its corps of instructors Mr. R. R. Miller, who recently completed the electrical course at the Ohio State University.

THE CENTRAL MACHINE AND FOUNDRY COMPANY, Quincy, Ill., is having much success with its direct electric elevator, as testified by letters received from those having them in use. The elevator is very compact and all of its parts show careful design.

THE AMERICAN FUEL ECONOMIZER AND ENGINEERING COMPANY, of 136 Liberty street, N. Y., recently furnished an induced draught system to the Electric Traction Co., Philadelphia. It also installed four large economizers which take care of 8,000-hp.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 44 Broad street, New York, has issued a circular and price-list No. 20, devoted to its iron armored insulating conduit. All of the various parts of this system are fully illustrated, and its application shown in several sketches.

BAKER & COMPANY, 121 Liberty street, New York, has issued a third edition, illustrated, of its useful pamphlet entitled "Data Concerning Platinum." The present edition is considerably enlarged over any previous edition and a copy will be mailed to any applicant mentioning the name of The Electrical World.

CHAS. A. SCHIEREN & CO., 45 Cliff street, New York, in their new tannery at Bristol, Tenn., are tanning leather by the old-fashioned process, using pure oak bark, thus producing a material that is especially adapted for leather belting purposes. The capacity of this tannery, which is in the heart of the best oak bark regions, is two hundred hides a day.

EDWARD HARRINGTON, SON & CO., Pennsylvania avenue and Fifteenth street, Philadelphia, calls attention in a pamphlet to their complete system of electric light and power-house equipments for the handling of heavy weights. The different hoists made by this firm are of the capacities from 500 pounds to ten tons. Their traveling cranes are of different types so that every conceivable case can be provided for.

MORRIS, TASKER & COMPANY, INCORPORATED, 222 South 3rd street, Philadelphia, Pa., have been made sole manufacturers of the well-known Duggan adjustable bracket. These brackets are made of wrought iron, and being of the simplest construction are cheaply manufactured, and the price has recently been further reduced. They may be purchased direct from this firm or from the Burnham & Duggan Railway Appliance Co., Boston, Mass.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports having secured the Western agency for the celebrated line of electrical railway supplies of the Lynn (Mass.) Manufacturing Company, which includes one of the best railway insulations ever produced, and will carry a large stock in Chicago and be prepared to ship entire equipments from that point. Special catalogue and advertising matter is being prepared and will be ready for distribution very shortly.

THE CENTRAL ELECTRIC COMPANY, Chicago, after having made exhaustive and careful tests of the B. & S. compounds and paints, will handle this product in the West, as General Western Agents. It reports that it finds the B. & S. products are the highest insulating mediums of their kind on the market, and states that it will carry a large stock in its Chicago warehouse, and has already secured sufficient orders to prove that the trade appreciates the superiority of this product.

THE NEW YORK & OHIO Company, and the Packard Electric Company, both of Warren, Ohio, have each issued an unusually handsome pamphlet, the former under the title of "The Packard Family," referring to an engraved group of incandescent lamps, and the latter devoted to the Packard transformer. Aside from the interesting matter contained, the catalogues are fine specimens of the printer's and engraver's art, and show that it is possible to obtain most excellent results on a small page, contrary to the usual opinion.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., reports the following recent sales of Watertown engines: One 100-hp high speed engine for the Louisville, New Albany & Chicago Railroad; one 100-hp high speed to the Grand Island Light & Power Company, Grand Island, Neb.; one 50-hp direct connected, to the Western Electric Company, of St. Louis; one 100-hp heavy duty engine, for export to Cuba; three small outfits for export to India; one 50-hp high speed, for C. F. Rumpp & Sons, Philadelphia, Pa., second order); one 50-hp Excelsior automatic, to J. Mason Gross, Wakefield, R. I.

MR. ALTON D. ADAMS, Electrical Engineer and Manufacturers' Agent, with headquarters at 43 Fourth street, Troy, N. Y., and 620 Atlantic aveue, Boston, is now handling a full line of electrical machinery, supplies and structural material, among which are charcoal iron stampings for armature and transformer cores, made by Turner Bros., London, Eng., and iron and steel forgings for electrical machinery. Mr. Adams is also about to put on the market a line of forged iron field magnet dynamos and power generators, from 20 to 200-hp capacity, of high efficiency and very light weights for their rated capacities.

THE SIEMENS & HALSKE ELECTRIC COMPANY'S factory, as our readers are aware, was destroyed by a great lumber fire in Chicago, August the 1st. The company made a lease with the Grant Locomotive Works, August 11, commenced moving into the new works August 15, and it finished and shipped the first generator, built entirely at the new factory, Oct. 15th. Every available tool in the new works is now in operation and many of the tools which were destroyed in the fire have been duplicated, so that from now on the company is in a position to finish one direct coupled generator each day. These few simple facts indicate the dauntless spirit of the company and it is certainly to-day in a better condition for competition in the electrical field than before the fire.

THE STUCKY & HECK ELECTRICAL MANUFACTURING COMPANY, No. 23 New Jersey Railroad Avenue, Newark, N.J., reports business to be increasing rapidly. It is especially busy reconstructing railroad motors, commutators and converters, and has just reconstructed two 70-volt Weston dynamos of 125 volts for the new Saenger Hall in Newark, N. J. At present the works are being removed to No. 35 New Jersey Railroad Avenue, opposite Market Street Depot, to a large three-story brick building which will be occupied entirely and where, besides its own direct current testing circuits, the 1,000-volt alternating circuit from the Newark Electric Light Station will be utilized. The Stucky & Heck Company has also undertaken the construction of the Ash automatic electric traction switch, which can be seen in operation at the corner of Broad and Bridge streets, Newark, N. J..

THE ELECTRIC APPLIANCE COMPANY, Chicago, is distributing two little catalogues, which will undoubtedly prove to be of interest, as they are the first separate catalogues published covering the goods which they list. The one is a complete catalogue of the Packard transformer illustrating and describing the process of manufacture and the detail of construction and giving data in regard to efficiency, regulation, etc. This is the first complete catalogue of the Packard transformer that has been issued. The other catalogue covers the complete line of Packard lamps from the "'Baby" to the "Mogul" with special appliances that have been designed by the Packard Company and manufactured solely by them for use in connection with their Mogul and other special

lamp... This catalogue lists for the first time the Packard theatre lamp, a special lamp for foot, border and bunch lights; the Packard stereopticon lamp (a substitute for calciums for theatrical work), and the focusing outfit for use in connection with same. In fact both of these catalogues are filled with information that will be entirely new to the majority of the trade.

HOUSTON, STANWOOD & GAMBLE, Cincinnati, Ohio, have opened an office in St. Louis under the management of Mr. A. Schen. The following is a list of those to whom standard engines made by this company have been sold since August 1. The Stratton-White Co., (two engines), Fort Worth, Texas; Pierce & Miller Engineering Co., (four engines.) New York, N. Y; Harvard University, Boston, Mass.; Pleasant Valley Paper Co., Middletown, O.; O'Harra Bros., Dalton, Fla.; W. O. Sugg, Hales Point, Tenn.; Wyoming Light, Heat, Water & Power Co., Wyoming, O.; E. E. Harrell, Sunsbury, N. C.; R. H. Wood & Co., Lorain, O.; American Sugar Refining Co., Boston, Mass.; Orange Lumber Co., Orange, Texas; S. B. Hornsby, Frogmore, La.; Grand Rapids Veneer Works, (two engines), Grand Rapids, Mich.; American Tool & Machine Co., Boston, Mass.; Oliver Davis, Tyronza, Ark.; John H. Herald & Co., (two engines), Lynchburg, Va.; Craig Lumber Co., Knoxville, Tenn.; Memphis Gin & Machine Co. (three engines), Memphis, Tenn.; Baker Bros., Dyersburg, Tenn.; Herring-Hall-Marvin Co., Cincinnati, O.; Laidlaw-Dunn-Gordon Co., (two engines), Cincinnati, O.; Cedar Point Seminary, Cincinnati, O.; Thompson Coal Co., (two engines), Actnaville, Ky.; Licking River Rolling Mill Co., Covington, Ky.; Fairbanks, Morse & Co., Denver, Col.; H. P. Gregory & Co., (two engines,) San Francisco, Cal.; American Cooperage Co., Friar's Point, Miss.

THE HUBLEY MANUFACTURING COMPANY, of Lancaster, Pa., is rapidly coming to the front, and is occupying a prominent position among its competitors in the electrical field. It is located at Lancaster City, in the eastern part of Pennsylvania, a location as central as could be desired and is nicely settled in its new plant, a mile from the center of the city on the Pennsylvania Railroad, branches of which lead into the works. With its iron and brass foundries, employing nearly one hundred moulders; machine shops, grinding, polishing and nickle plating buildings and warehouses, all equipped with new machinery of the latest and best patterns, employing over three hundred hands, it has one of the most complete and best appointed plants in the state. On account of its rapidly increasing business, however, it finds it necessary to erect at once a new foundry building, which will give employment to nearly one hundred more moulders; and also to erect a large two-story building for manufacturing purposes. The company manufactures a full line of overhead street railway material, using the celebrated Medbery insulation. Its line of ears, straight line, anchor, feeder and splicing ears, are of new design and are both light and strong, and are made to solder on; a complete line is also made to hammer on, a feature which is being demanded by a number of managers on large roads. It is the sole manufacturers of the Cope come-along, which is one of the most useful tools in construction work, and has been greatly improved, a ring being introduced at the end, instead of a hook, as in the old form, making them stronger. The jaws are slightly curved on their bearing surface and have a checked grooving, instead of being straight and having a filed grooving as in the old form. This ensures a firmer grip on the trolley wire and is less liable to drop. In the construction department it has several large contracts on hand, among the most important may be mentioned the contract for forty-three miles of electric railway for the Pennsylvania Traction Company, a fifty-mile telephone line, and the equipment of an electric lighting plant of one thousand lights capacity.

Business Notices.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 16, 1894.

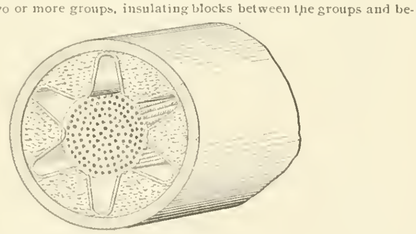
(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

527,601. CONDUIT ELECTRIC RAILWAY.—O. B. Finn, Philadelphia, Pa. Application filed March 16, 1894. This comprises a box adapted to hold the circuit-forming mechanism mounted on bearings, whereby it may be turned upwardly.

527,559. ELECTRIC ARC LAMP; A. H. Moses, St. Louis, Mo. Application filed January 21, 1893. A lamp having an air-tight connection between the casing and the globe.

527,297. UNDERGROUND CONDUIT; J. E. Edwards, Toronto, Canada. Application filed June 7, 1894. This comprises outer pipe sections, inner supporting racks having projecting flanges, the racks and pipe sections being provided with openings for the purpose of making the connection with the wires.

527,730. THEOSTAT; A. J. Shaw, Muskegon, Mich. Application filed March 15, 1894. This consists of a metallic band folded back and forth in short lengths in two or more groups, insulating blocks between the groups and between the folds of each group, and binding bands passing about the groups and serving to hold the same in a compact body.



No. 527,414.—ELECTRIC CABLE.

527,546. TROLLEY; W. H. Bache, Bound Brook, N. J. Application filed October 31, 1893. This comprises a support, bracket and wheel, a pivoted contact arm and an operating cord.

527,518. SECRET TELEGRAPHY; A. D. P. Weaver, Jackson, Mich. Application filed December 26, 1893. This comprises a rheostat and key, an extra relay, an extra sounder, an ordinary relay and sounder and a battery for the local circuit.

527,501. MULTIPLE SAFETY CUT OUT; J. F. McLaughlin, Philadelphia, Pa. Application filed January 18, 1890. This consists of a series of easily fusible conducting strips, a spring actuated switch adapted to include any one of the strips in the circuit, a hand-switch also included in the circuit and a detent in operative relation to both switches, whereby the spring actuated switch is locked when the circuit is opened by the hand switch.

527,528. ELECTRIC CLOCK; C. Gullberg, Jersey City, N. J. Application filed September 16, 1893. The combination of an electro-magnet, a pendulum subjected periodically to the pull thereof, a ratchet wheel actuated by the pendulum, a circuit closing switch and switch releasing lever, the lever periodically subjected to a stud on the ratchet wheel, and the wheel adapted for actuating the time train.

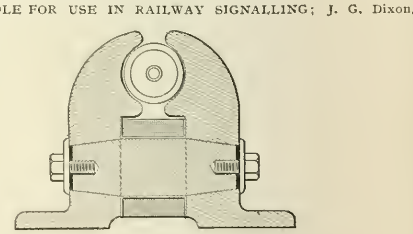
527,556. WEATHER PROTECTING COVERING FOR ELECTRICAL CONDUCTORS; E. J. Houston, Philadelphia, Pa. Application filed November 17, 1891. The combination with a contact wire, of a thin, pliable, continuous, adhesive, permanent, weather protecting coating of carbon, substantially integral therewith.

527,415. DYNAMO ELECTRIC MACHINE; E. Fawcett, Alliance, Ohio. Application filed February 15, 1894. The combination of a field piece having a tapering end and a polepiece having a tapering opening to receive the tapering end of the field piece.

527,461. APPARATUS FOR SIGNALLING THE APPROACH OF STREET CARS; G. B. St. John, Kalamazoo, Mich. Application filed November 27, 1893. This comprises a group of signals connected by a single wire, and a circuit closer operated by the car.

527,436. PRIMARY BATTERY AND PORTABLE ELECTRIC LAMP; S. W. Maquay, London, England. Application filed January 4, 1894. This comprises the cells, a frame, insulated rods attached to the frame, a liquid tight plate carrying stuffing boxes through which rods pass, and zincs in the form of plates carried on the flat by the rods.

527,481. TREADLE FOR USE IN RAILWAY SIGNALLING; J. G. Dixon, Birkby, England. Application filed February 20, 1894. The combination of a depressible treadle, and counterbalanced and pivoted lever, of a dash pot cylinder, piston, and piston rod connecting the lever and piston, an insulated contact piece normally above the piston in the cylinder, and two conductors connected respectively to the contact piece and cylinder, the circuit being completed by the ascending piston.



No. 527,415.—DYNAMO ELECTRIC MACHINE.

527,414. ELECTRIC CABLE; T. J. Dewees, Palmyra, N. J. Application filed June 20, 1894. The combination of a metallic cable formed of flexible conductors, and inclosing irregular sheath of paper or fibrous material secured about the cable in a manner to form air spaces adjacent to the cable, an inclosing lead sheath or outer tubing, and quick lime contained within the outer head tube and supported by the paper covering of the cable.

527,608. LIGHT INDICATOR. L. F. Johnson, Poughkeepsie, N. Y. Application filed April 17, 1894. This comprises a switch lamp, a thermostatic circuit controller supported in proximity thereto, a battery and magnet, a signal arm carried by the armature of the magnet, a normally open shunt around the circuit closer and magnet adapted to be closed by the release of the armature, and an audible signal included in the shunt.

527,759. TELEPHONE CALL REGISTER; W. T. Gentry, Atlanta, Ga. Application filed April 20, 1894. The combination, with the telephone station instrument of a tumbler adapted to receive a key and having connection with a sounder and adapted, by its rotation, to operate same, and a counting train and dials, the train being connected with the tumbler.

The Electrical World.

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CONTENTS.

RAPID TRANSIT IN NEW YORK.

There is every prospect that at the election next week there will be a large majority in favor of the rapid transit measure for New York City. In the report of Chief Engineer Parsons and in the address issued to voters by the Rapid Transit Commission, strong grounds are taken in favor of the use of electricity for a motive power, so that there is no question as to the adoption of electric traction in the final plans. That there should have existed any doubt on the subject has been due to the opponents of the measure, who have not hesitated to pronounce that method as only in the experimental stage and otherwise discredit it, notwithstanding the success of the electrical underground roads of London and the entire engineering feasibility of electric traction on roads much more extensive than the proposed ones. While the successful carrying out of this great undertaking on the lines indicated will be of incalculable value to New York, it will also doubtless result in the adoption of the same system in other cities, and in other directions also cause a greater development of electric traction.

LIGHT FROM ELECTRIC OSCILLATIONS.

Elsewhere we reprint an article by Prof. Ebert which is of interest on account of giving some quantitative results in regard to the energy expended in producing light by means of alternating currents of high frequency. The experiments referred to do not seem to add anything new to the knowledge we have received of high frequency phenomena from the magnificent work of Tesla, but the simple apparatus described places it within reach of the ordinary experimenter to enter on the study of this most interesting subject. As will be seen, the author confines himself to phosphorescent effects, and to the determination of the efficiency of what he calls the "luminescent lamp." The result is startling, as it was found that the high frequency lamp consumed from 1,500 to 2,000 times less energy than the amyl acetate standard with which the comparison of light was made. To be sure, the amount of light produced by the luminescent lamp experimented with was insignificant, but then the author does not intimate that more powerful effects cannot be attained. The author refers to the difficulty of distributing high frequency currents and makes the suggestive comment that this to a certain extent may be obviated by having the necessary transforming apparatus in the base of the lamp, as the capacities and inductances necessary are small.

THE PHILADELPHIA ELECTRIC RAILWAY SYSTEM.

In this issue we give another installment of Prof. Hering's engineering account of the electric railway system of the Philadelphia Traction Company. As this plant is probably the most thorough one in all of its engineering details yet installed, our readers interested in the subject will do well to make a careful study of the article. It will be noted that each power house has a test room thoroughly equipped with the necessary instruments, and that there is a special car fitted with instruments to make tests along the line. These are commendable features and show an intention of not trusting to the usual hap-hazard methods to keep the plant in an efficient condition, and the thorough system of testing circuits and connections is further evidence of this, implying that the problem has been worked out in a systematic manner. Some power houses that have a fair equipment of testing apparatus might as well be without them on account of the absence of such a system. Indeed, in many cases there is little doubt but that the instrument equipment is regarded merely in the light of a scientific exhibit whose greatest service is to impress the public with the mysteries they represent, and heighten its regard for those who are supposed to understand

them. Mr. Fritz Uhlenhaut, the chief engineer of the company, has demonstrated that he is thoroughly well qualified for the position he has so ably filled, and when we learn that he was formerly connected with the Brooklyn Edison Illuminating station, it is not difficult to understand why so much stress has been laid upon electrical points usually entirely neglected in electric street railway practice.

COSMIC ELECTRICITY.

Dr. H. R. Rogers in a pamphlet advances the theory that the solar system is a vast dynamo, and that light and heat are the result of an electric current between the earth and the sun. According to his theory, the sun and earth revolving on their axes and in their orbits, constitute a vast "terra-solar" electrical machine, to the action of which are due the currents which incessantly come from the sun to the earth. Extending the principle of the dynamo from the solar to the celestial field, he considers it a legitimate inference that the stellar worlds, whirling in space, also evolve between them electrical currents in great cosmical circuits. The author remarks that "given motion and magnetism, and "they can be used in explanation of all observed phenomena of "inorganic matter, from the cohesion of the particles in a clod to "the order of the solar system." As the planets move the only assumption necessary on these premises is that the sun is a magnet. What an infinity of speculations could be built up on such logic! The doctor is taken seriously, however, by a newspaper writer who exclaims : "So powerful does this theory of electricity as the direct "agent in the application of primal force compel the imagination, "that its utmost flights on the wings of less developed theories are "as nothing to what may be expected of it if science generally "adopts electricity as the general agent of the application of cos- "mic force. Instead of such crude vehicles of imagination as pro- "jectiles overcoming the attraction of gravitation, the Jules Verne "of the future will take advantage of the electric currents connect- "ing different bodies of the solar system to call up the moon by "telephone and to connect Mars or the sun by telegraph. The "electric theory annihilates space and makes mock at time."

THE MIDWINTER FAIR.

Elsewhere Messrs. Hasson and Hunt give a very full collection of engineering and other data relating to the electrical features of the Midwinter Fair, held at San Francisco the first months of this year, and which was at the time very fully described in our columns. The chief interest attached to the data given does not relate to any efficient character of apparatus installed, for this was of the most haphazard description, nor to any particular economy in operation, which was impossible under the existing conditions. It consists rather in furnishing an object lesson showing what may be accomplished under the most hopeless conditions by engineers through a resort to expedients, and the vigorous exercise of executive ability. Notwithstanding the fact that in a limited time the electrical apparatus had to be gathered piecemeal and forwarded across the continent, the boilers and engines, new and second-hand, sought for in every part of the Pacific slope from owners apparently none too willing, and the odd assortment fitted to each other and the end in view, the electrical department was the only one ready on opening day, and during the exhibition its operation was as successful, so far as the Fair was concerned, as if at all parts of the plant had been especially designed for the purpose. While, as before stated, a high economy of operation was out of the question under the existing conditions, yet the results attained are very fair. The system of management cannot be too highly commended that comprised such an exhaustive method of classifying and keeping account of the various expenditures, and in this respect it serves as a model worthy of study by those who recognize the importance of this point in connection with every electrical plant.

POLARIZED ELECTRICITY

A Dr. A. H. Stevens, of Philadelphia, claims to have made an important discovery in the treating of diseases by means of "electrical polarization." In a work on the subject which he has written, he states that books have erroneously undertaken to explain the circulation of the blood by "cardiac or heart power", which he declares to be false—"neither true nor philosophical, "being impossible from a natural law or standpoint." He claims to have undisputably proven that the blood is "both cleansed "and circulated through the entire system outward and brought "back, by the positive and negative forces of polarized electricity "as carried by nature herself from her own laws of balance and "equilibrium." He says that it is the "universal distribution of "this omnipresent element (polarized electricity) in the human "organism, viz.: too much in one place and too little in another, "that is, or produces, what we call disease," and his system consists in the application of a positive or negative electrode to restore the normal condition. The terms *electricity*, *polarizotion*, *positive* and *negative* appear to have great efficacy with the public, their use seeming to have a mysterious effect on the reasoning faculties which cause to be accepted as plausible the most absurd theories. In the present instance the author (who has something to sell) does not seem to consider it necessary to give the slightest plausibility to his arguments, apparently assuming that an involved use of the words referred to will alone have the desired effect in gulling the class to which he appeals. In order to catch attention, however, patriotism is appealed to, and the public reminded that "this new cure was born, or discovered, and first made known here "in our own beloved America, and not on the other side of the "great Atlantic," and some very sarcastic remarks are indulged in respecting "a certain Doctor Kotch, of Berlin, Germany," a rival to Dr. Stevens in the cure of consumption.

Electric Street Cars in Chemnitz.

A report by J. C. Monaghan, United States Consul at Chemnitz, Germany, states that city has banished horses from her street cars, substituting the trolley system of electrical propulsion. Instead of poles, the wires are hung from house walls. The system is simple, cheap, convenient, easily adjustable, and free from much of the ugliness inseparable from a network of wires.

The method of stringing or laying the wires is by rosettes fastened into the woodwork or walls of the houses, from which project hooks to which the wires are attached. In case of wooden walls, huge screws are placed into the wall; in case of stone, a long jagged iron is driven in and cemented. These are then tested with at least seven times the weight that they are expected to bear. Owners of houses, without exception, preferred to allow the use of their houses free to having a post on the sidewalk. The company holds signed and sealed documents from house-owners giving a year's right to the use of the walls for hooks and a further agreement to give a year's notice for removal. The system has now been in operation for six or eight months and has proven satisfactory and successful. No one has given notice to remove the hooks.

The cars have no conductors. The motorman is the only person on board who represents the company. By doing away with conductors, the company saves annually 44,000 marks. The fare is only 10 pfennigs, or a trifle less than 2½ cents on all routes, including transfers. Should 150,000 persons evade payment in twelve months, the loss would be 15,000 marks, or a very small trifle, not more than one-third of the 44,000 marks saved; 450,000 persons must evade fares in twelve months before the company's 44,000 marks of savings in salaries are made up. Among the people who pay for food and drink in saloons, beer gardens, etc., on their honor, not 150,000, 100,000, nor even 50,000 in a year evade fares. The consul is perfectly satisfied that the present system works successfully. In cases of evasion of fare, persons are punished both in the courts and by publicity in the newspapers—this latter to warn others. Fare boxes are attached to the front and rear parts of the car, hence no one has any excuse to offer as to difficulty of getting forward. Then, too, the "public eye" is always watching, and nobody wants to be even thought guilty.

Public opinion was divided between the trolley (overhead) and the underground system now operating in Budapest. It was claimed, and pretty satisfactorily proven, that in northern cities, where snow falls heavily and lies on the ground a long time, not only is the trolley best but the underground system is not satisfactory. The consul did not learn if any opinion was expressed as to the merits of the storage system.

Meeting of American Institute of Electrical Engineers.

At the October meeting of the American Institute of Electrical Engineers. two very highly mathematical papers were presented, one by Lieut. Samuel Reber, U. S. A., read by title, on "The Theory of Two and Three Phase Motors" and the other by Mr. Charles P. Steinmetz on "The Theory of the Synchronous Motor," which was read by the author.

The paper by Lieut. Reber gives an approximate mathematical solution of two and three phase motors on the assumptions that the change of magnetic properties of the iron and magnetic leakage are neglected, that the self-inductances are constant, and that the mutual-inductance between armature and field circuits follows a sine law, and that the field is supposed to be without projecting pole pieces. On these assumptions very elaborate equations are built up. Among the conclusions are that at a certain speed the torque of the type of motors considered is a maximum, and that a motor pushed in its work beyond this speed will stop, to prevent which the motor should not be loaded to a point more than half the maximum torque. The equations show that two and three phase motors have the same properties and differ only in constants, and that the most important relation is that of the armature resistance to the armature self-inductance speed. Constant current multiphase motors with no condenser will start well, have a low efficiency and will regulate poorly, owing to the torque decreasing if the speed is too slow. When the point of maximum torque comes near the point of maximum speed there will be good regulation, but the starting qualities will be poor unless resistance is introduced at the start and then cut out. A starting resistance is necessary in high efficiency motors. With a condenser in the armature circuit the starting torque can be increased without changing the resistance and thus increase of torque obtained, not by increasing the current in the field circuits but only in the armature. By the use of a variable condenser the speed can be made to increase up to synchronism and there is no overheating at low speeds nor waste of power by the insertion of resistance to increase the torque.

The torque and work of motors running under constant E. M. F., neglecting the change of the magnetic properties of iron at high magnetization, vary as the square of the field current. When the motor is at rest or just starting, the current is very large, and if there are other motors or lamps in the exterior circuit they are rendered unsteady at the moment of starting of the first motor, which may, however, be corrected by a secondary transformer. High frequency motors require a starting resistance, and in such motors the torque can be readily regulated by adjustment of the armature resistance, thus enabling the point of maximum torque to be thrown at any speed desired, and the smaller the magnetic leakage the more efficient will be the motor.

Lieut. Reber states that it is an advantage to increase the frequency until the hysteresis heating becomes too great or the motor runs too fast. Increase of speed gives an advantage in output until the machines begin to overheat. With a condenser the same facts hold but with the advantage that an increase in the frequency greatly reduces the size of condenser necessary. A high frequency motor will weigh less than a low frequency one, but when the clearance is large this advantage is not so decided, and when very large, low frequency motors are better if weight is no objection. The high frequency motor will contain less iron and more copper, and if the size of the motor is varied, keeping the magnetization constant, the output and hysteresis vary directly as the weight and as the heating of the field and armature circuits.

In the discussion, Prof. Pupin spoke highly of Lieut. Reber's paper and method. Mr. Steinmetz, while paying a compliment to the ability displayed by the author, objected decidedly to the mathematical method of the paper for the treatment of engineering problems. He showed a method of his own which he stated was much simpler while at the same time more comprehensive. Mr. Kennelly supported Mr. Steinmetz in respect to the superiority of his method.

In the introduction to Mr. Steinmetz's paper on "The Theory of the Synchronous Motor," the author states that the theory contained was written something over a year ago but was not intended for publication; owing, however, to the fact that Prof. S. P. Thompson's paper on "Some Advantages of Alternating Currents" read before the British Association, has brought the synchronous motor into discussion again, the paper is now published.

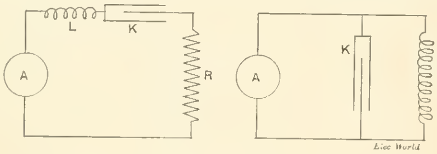
The treatment employed in this paper is also highly mathematical. It is shown that the two sides of the V-shaped curves of synchronous motors running light, published by Mordey and others, are not, as usually assumed, straight lines, but arcs of ellipses, the one of a concave and the other of a convex curvature. A deduction from these curves is that at no load the current of these motors can be many times larger than the current which would pass through the motor while at rest, having, in fact, the same value as would exist if flowing through a non-inductive circuit of the same resistance. The displacement of phase, lead or lag is a maximum when the power of the motor equals the power consumed by the resistance, that is, at an electrical efficiency of 50 per cent. Other deductions are made, but are only intelligible in connection with the equations to which they refer.

The Chicago meeting of the Institute was largely attended, the audience numbering not far short of a hundred. Prof. Stine, of the Armour Institute, had thoughtfully prepared lantern slides to illustrate the winding of induction motors, which added greatly to the interest of the meeting. Among those who took part in the discussion of the papers of Messrs. Steinmetz and Reber were Messrs. Stine, Sage and Edison. Prof. Owen's paper on the "Test of a Closed Coil Arc Dynamo," and Mr. E. G. Willyoung's paper on "Standardizing Electrical Measuring Instruments" were also discussed, the former by Mr. H. H. Wait and the latter by Prof. Stine, R. A. Stone and E. W. Ray. Mr. F. A. Hamilton, a member of the English Institute of Electrical Engineers, upon invitation of honorary secretary, B. J. Arnold, gave an interesting talk about various technical points in connection with ocean cables, on which subject he is a recognized authority, having been connected with ocean cable work for eighteen years.

Alternate Current Working—VIII.

BY HARRIS J. RYAN.

In practice all the conditions implied in the preceding formulas as necessary to obtain an exact balance between inductance and capacity could not in general be exactly realized. The results obtained for an actual case of this sort through an investigation conducted by Dr. Bedell and the writer are given graphically in Fig. 26. In this instance the alternator A, see Fig. 25, furnished current at a pressure of 1,080 volts and 143 p. p. s. A Swinburne 30-light "hedgehog" transformer was used at L; its induction current at no load, that is, with the secondary on open circuit, was .95 amperes. At K was placed a Stanley condenser that has a capacity of 1.02 microfarads. The instantaneous values of



FIGS. 24 AND 25.

the primary and secondary E. M. Fs. and the line currents between A and K and the transformer induction current between K and L were observed. In the diagram, Fig. 26, the corresponding curves are drawn. The induction current is labelled the primary current. The induction current is .95 amperes and the line current .187 amperes. The line current is made up of the differences between the induction and condenser currents. In this case the line current could never be practically reduced to zero. To reduce the line currents practically to zero the impressed E. M. F. and the induction current would have to conform to true sine curves, then the condenser current would vary as a curve of sines, and an exact balance could be brought about by adjustment. Here the alternator pressure does not quite form a sine curve, and the transformer induction current departs still more from the sine form on account of the irregular forces that are necessary for induction through the iron core. The condenser current presents a form such that its value at all instants is proportional to the rate of change of the E. M. F. impressed on its terminals. When the capacity of the condenser was adjusted so that the line current was a minimum, the residue current, which is the difference between induction and condenser currents, was determined and plotted in the diagram Fig. 26 as the line current. The curve labelled "condenser current" is determined by adding the ordinates of the line and the induction currents. The condenser reactance E. M. F. curve was determined graphically with the use of the planimeter by the method described in the Electrical World, Vol. XXIII, No. 1, p. 9, while the broken curve is the same curve actually observed as impressed E. M. F. The difference between the two curves is due to the condenser hysteresis, which in effect acts very much like the internal resistance of a storage battery. The reader should note the form of these

curves; they give one a good idea of the effects produced when the impressed E. M. F. departs from the sine form.

For the benefit of the reader who desires to go over the observed curves in Fig. 26 for the purpose of determining those deduced, the scales and areas of the original diagram are here given:

Length of one complete period	5.75 in.
" " 1,000 volts	1.63 in.
" " 1 ampere	.8 in.
Time of one complete period	1-142 sec.

Value of one square inch of area enclosed by condenser current, 1,490 volts, determined as follows: Remember that one ampere

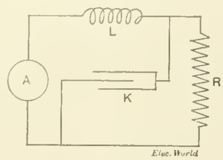


Fig. 27.

established through one farad for one second would produce a uniform rise of pressure in the condenser from zero to one volt, and through a microfarad this rise would be 10^6 volts. On the diagram consider one ampere to have been established through the condenser during the time of one completed period 1-142 or .007 seconds. At the end of this time the condenser pressure would be

$$\frac{10^6 \times 1 \times .007}{1.02} = 6,860 \text{ volts.}$$

The area developed in the diagram by one ampere through .007 sec.

$$.8 \times 5.75 = 4.6 \text{ sq. in., whence}$$

$$1 \text{ sq. in.} = 6,840 \div 4.6 = 1,490. \text{ volts.}$$

In the diagram the area enclosed by the condenser current is divided into sections and the areas from the zeros to the ends of each section as originally observed on the planimeter are recorded in the diagram. The products of these areas into 1,490, the volts per square inch give the E. M. F.'s that located the curve "E— obtained graphically from C."

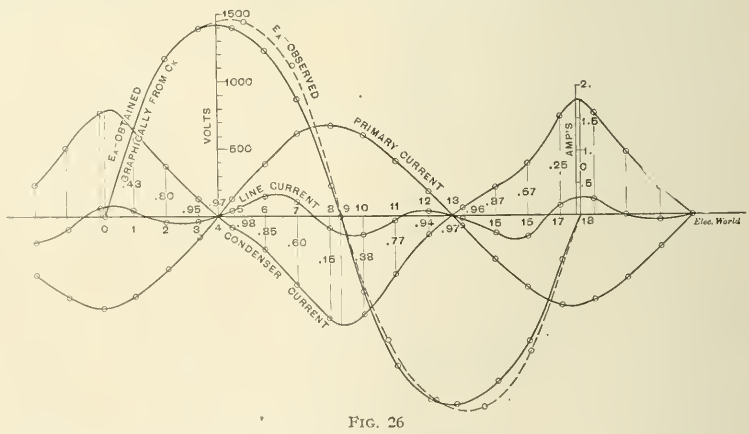


Fig. 26

The capacity by computation that should produce a current that would balance the induction current is

$$\frac{C}{K \times 10^{-6}\,\omega} = \frac{.95}{K \times 10^{-6} \times 2\pi \times 142} = 1,080$$

$$K = .985 \text{ microfarads,}$$

while 1.02 microfarads were used in the experiment.

The diagram of Fig. 27 illustrates a circuit that is now met with occasionally in practice. A is an alternator that furnishes power to lamps or motors at R, the line thorugh its own properties or those of auxiliary apparatus possesses inductance and capacity, represented by L and K. The induction reactance is in series with the load resistance and the capacity reactance, the last two being in parallel. The effect of the reactance of L and K is to elevate the pressure on R over and above what it would be without the presence of the capacity K. What pressure will R be subjected to when A produces 10,000 volts at 125 p. p. s.? L = .383 henrys; K = 6.35 microfarads; and R = 100 ohms. A graphic solution of the problem will be made. In doing this the first thing is to fix the relative positions and amounts of the several currents and E. M. F.'s. Assume K to be subjected to a pressure of 10,000 volts, and from the relation

$$E = \frac{C}{K\omega}$$

we find the current through K to be

$$C = E\,K\omega = 10,000 \times 6.35 \times 10^{-6} \times 785$$

$$C = 5. \text{ amperes.}$$

At 10,000 volts the current through R will be 10 amperes. In Fig. 28 these currents are plotted with proper positions and values.

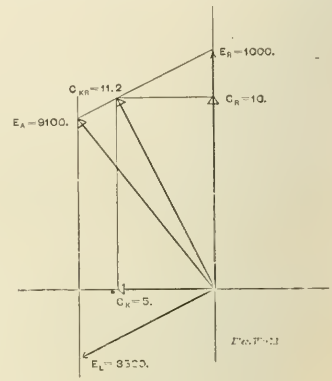


Fig. 28.

In the diagram C_{KR}=11.2 amperes is the current that passes through L, whose reactance produces an E. M. F.

$$E_L = C\,L\,\omega = 11.2 \times .383 \times 785$$

$$E_L = 3360. \text{ volts.}$$

Remembering that the E. M. F., which overcomes the pressure caused by induction reactance, is 90 degrees in advance of the current, E_L = 3,360 is plotted, therefore, to the left at right angles to C_{KR}. The diagonal of the parallelogram formed by E_R and E_L is the pressure E_A = 9,100 volts that the alternator must furnish in order to maintain a pressure on R of 10,000 volts. We have now determined the positions and relatives values of the E. M. F.'s and currents for this circuit. So long as K L and R remain constant the positions will remain the same, and the values will retain the same relative proportions. Therefore if A furnishes 10,000 volts, the pressure maintained on R will be

$$\frac{10,000 \times 10,000}{9,100} = 11,000 \text{ volts.}$$

The remaining values would be increased in the same proportion, for example the alternator current C_{KR} would be

$$11.2 \times 1.1 = 12.3, \text{ amperes.}$$

(To be continued)

ELECTRIC SYSTEM OF THE PHILADELPHIA TRACTION COMPANY

BY HERMANN S. HERING.

III.

POWER DISTRIBUTION (Continued).

The general system of feeding a line, together with the arrangement of subways, manholes, etc., is shown in Fig. 19, which, however, contains only the circuits for two of the lines, but it is a typical diagram and shows the method adopted for all of the lines operated by this company. The enlargement of the vicinity of 13th and Mt. Vernon streets, in the lower portion of the diagram, shows

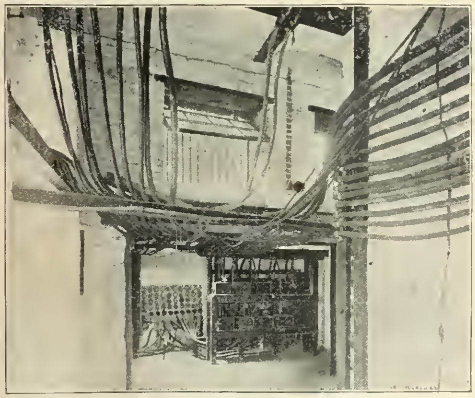


FIG. 22.—ONE OF THE VAULTS, STATION B.

the feed cables clearly, and gives their cross section in circular miles, together with their designating number.

By following any one of these cables from the station, the section it feeds can readily be found, the number and location of the taps, the feeder poles, manholes, etc. The section insulators show the limits of the portion of the line fed by any one cable. The dotted lines drawn in the middle of the street show the location of the subways. The cables are of necessity drawn diagrammatically and obviously belong in the subways of the streets which they feed and near which they are drawn. For instance, cable No. 22, 400,000 circular mils, starts from manhole 173 at 13th and Mt. Vernon, runs down 13th street to Wood street, west on Wood street to 15th, south to Chestnut street, west to 16th and down to Pine street, where it terminates, having a total length of about 8,120 feet. It feeds the 16th street line from near Market street to near South street, a distance of 3,000 feet, and is tapped at manholes 36, 39 and 41, which are about 1,000 feet apart. As another illustration, follow cable No. 2, 500,000 circular mils cross-section; starting from manhole 363, near the station, it runs out Ridge avenue to 15th street and then north to Berks street, a distance of about 6,960 feet. It feeds the line from near Norris to near Master street, a distance of about 3,200 feet, and is tapped at manholes 120, 123 and 127, which are a little over 1,000 feet apart. The taps are numbered with the number of the cable. Roughly the taps are made about 500 to 1,000 feet apart, and the manholes located from 200 to 500 feet apart, 400 feet being the standard. On these two lines there are 100 taps and 373 manholes. Diagrams of this character and scope are prepared for every line operated by this company and are used by the supervising engineers in directing the linemen in locating trouble, making repairs and testing cables and for general reference in the office.

The longest cable for these lines is No. 8, 700,000 circular mils cross-section, which feeds the south end of 15th street, its length being about 16,160 feet.

These two lines have a length of about 22 miles of single track and run about 130 cars, at an average of about 2½ minute intervals. They are fed by means of 31 cables, aggregating a length of 250,560 feet, or about 47½ miles, and having a total cross section near the station of 14,481,200 circular mils, which is equal to 11.37 square inches.

The total mileage of feeder cable operated at present over the entire system, is 225 miles, but more is being laid continually for the extensions. These two lines represent about one-third of the car equipment and one-fifth of the mileage of the system as it is operated at present.

The cross section of the cables was calculated for a maximum rise in temperature of 14 degrees, with a liberal allowance for increased traffic and for extra loads caused by blockades, etc., as the cables were to be laid permanently. The sum of the cross sections for any line do not represent the proportional output of the station for that line, but each cable was calculated for the maximum possible load to which it might individually be subjected without overheating or causing much drop in pressure. For instance, any feeder could supply, without danger, all the cars that could possibly run on its section and at the same time take care of an adjacent section whose cable may have become disabled. In a permanent underground system, in a large city, such precautions are imperative, and although this company has been severely criticised for laying so much copper, they have shown their excellent judgment in equipping their system in the most substantial manner, and will greatly benefit thereby.

The return feeders consist of twisted tinned copper wire, of 1,000,000 circular mils cross section at the station, and one of these run along each subway, and is connected with the rails at every manhole. This feeder is not grounded along the road, but runs direct to the negative bus bar on the station switchboard, thus practically preventing electrolytic action. The lead armor of the feeder cables is connected with the return feeder at every manhole to neutralize any potential difference that might arise there and cause electrolytic action, and so the lead sheathing acts as a return also. The return feeders are calculated for maximum demand on any line, and therefore for the maximum station output for that line. There are about 52 miles of return cable in operation.

UNDERGROUND CONSTRUCTION.

As already mentioned, the underground system of this company is the most extensive of any line at the pesent day, and its operation is being watched by many railway companies, as the question of

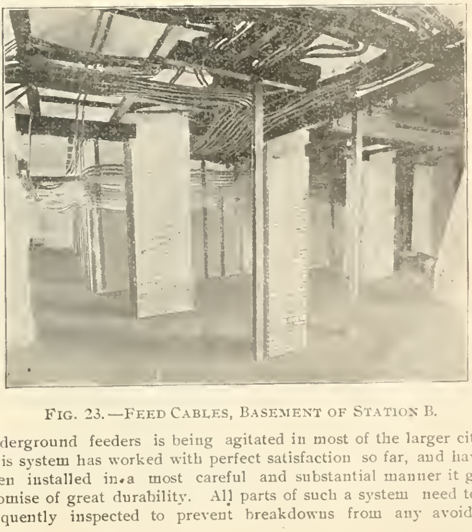


FIG. 23.—FEED CABLES, BASEMENT OF STATION B.

underground feeders is being agitated in most of the larger cities. This system has worked with perfect satisfaction so far, and having been installed in a most careful and substantial manner it gives promise of great durability. All parts of such a system need to be frequently inspected to prevent breakdowns from any avoidable causes.

The subways are composed of conduits made of a tough wrought

iron shell, lined with about 3-16 inch of cement concrete whose interior surface is smoothly finished, leaving a hole about 3 inches in diameter through which the cables are drawn.

These conduits are laid together with about three inches of concrete between them, and all placed about two feet below the level of the street. Manholes are located about 200 to 500 feet apart and are built up of brick walls and have cast iron covers and water tight plates. The cables are connected in water tight junction boxes, from

Fig. 23 is a view of a portion of the basement at 13th and Mt. Vernon streets, looking from one of the vaults, and shows the feed cables on the ceiling. A diagram of the junction box used in the vaults, is shown in Fig. 24. This was designed by the company's engineers and is very simple in construction and has proved very satisfactory so far. It consists of a cast iron base, with terminals into which the wires are brought and securely fastened and insulated. Connections are made with links and locked wing-nuts. A wood-

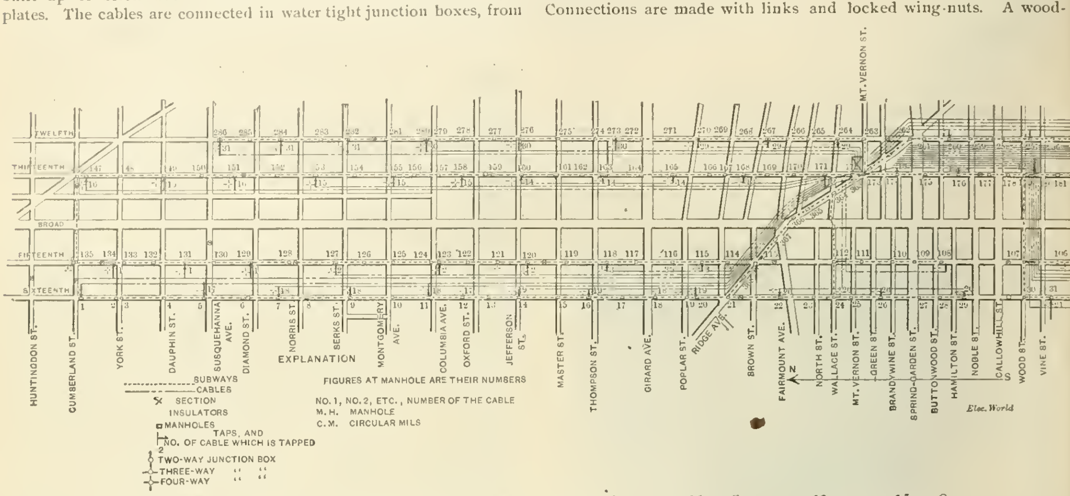


Fig. 19.—Map of Subways, Feed-Cables and Man-Holes, 12th and 16th Sts. and 13th and 15th Sts.

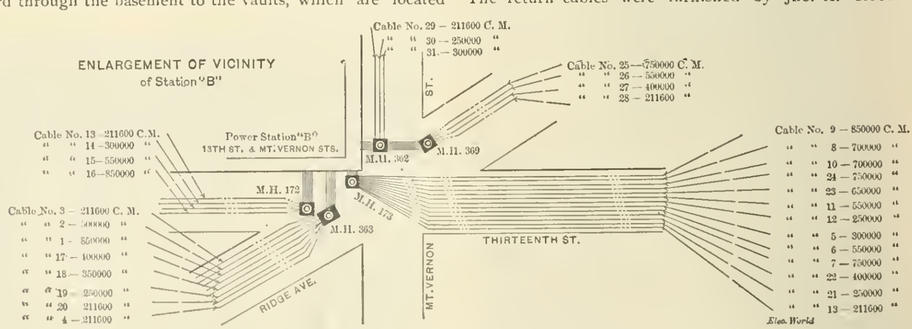
which all taps are made; and at which any section of cable can be disconnected in case of trouble. The manholes are connected with the sewer by means of bell-traps, but water rarely gets into them. At present* there are 1,209 manholes and 425 feeder junction boxes in the entire system, and the length of single duct laid approximates 800 miles.

Fig. 20 is a sketch of the underground and overhead construction, and shows the section of a manhole with subway, junction box, tap and return feeder. This subway has only four ducts, but some contain as many as 70, the number depending upon the largest number of cables likely to be laid in that vicinity. The overhead construction will be referred to later on.

In all of the power stations the feeders are brought from the switchboard through the basement to the vaults, which are located

lined cast-iron cover is bolted to this base and made water tight by a rubber gasket.

The feeder cables for the entire system which are lead-armored and braided, were furnished by the Standard Underground Cable Company, of Pittsburg, and range in size from 211,600 circ. mils to 950,000 circ. mils, the style used being the regular "Standard" lead covered "Waring" cable. In addition to the lead cover the cables are protected on the outside of the lead by a heavy protective braid saturated with a preservative compound, or with a tin coating. Some idea of the extent of the work in Philadelphia may be conveyed by the fact that the Standard Company has been laying cable there at the rate of 10,000 to 12,000 feet per day for more than a year, and that it has already laid over 600 miles of heavy feeder cables. The return cables were furnished by Jno. A. Roebling's Son's



Enlargement of Detail in Fig. 19.

under the sidewalks. In these vaults are the junction boxes which connect the station cables with the street cables.

Fig. 21 is a plan and section of the four vaults at 13th and Mt. Vernon streets and shows the method of construction. Fig. 22 is a view of one of these vaults and shows the terminus of one of the subways and a bank of junction boxes, together with the cables leading to them. The cables of twisted wires seen in the middle of the picture, are some of the return feeders, and are more than an inch in diameter. The windows are the basement windows looking into 13th street.

*Oct. 1, 1894.

Company, of Trenton, N. J., and the conduits by the National Conduit Company, of New York and the Wycoff Creosote Tube Works of Williamsport, Pa. The manhole tops, of which there are over 1,200, were made by the Pennsylvania Iron Works Company.

OVERHEAD CONSTRUCTION.

The general sketch of the side pole construction is shown in Fig. 20, and this constitutes the style of most of the equipment, there being but little centre pole construction, not more than five miles. The poles are of the best quality of wrought iron pipe and were furnished by Morris, Tasker & Company, of Philadelphia. They are about 28 feet long, of extra heavy pipe, built in 4, 5 and

6-inch sections, though some of them are much heavier. They are set in $5\frac{1}{2}$ feet of concrete formed of Portland cement, slag and sand. The poles are set about 125 feet apart, and at present there are about 15,000 in use. At the feeder pole head, where the feed wire is brought out to be connected with the trolley, there is special precaution taken to avoid grounds. The insulated wire is brought up the interior of the pole, and at the top is connected by means of a junction with a wire running to the trolley span wire by which the trolley wire is fed. This junction is made by means of two brass lugs, which are soldered, one to the wire from the conduit and the other to the wire going to the trolley. The joint of the cable wire is embedded in compound and protected by a hard rubber plate. These two lugs have a conical joint and can be wedged anchored on each side of curves and about every 1,200 feet on straight stretches.

Lightning arresters, which are connected to the return feeders are placed on every feeder pole, and a choking coil is placed on the trolley feed wire between the feeder head and trolley wire.

TRACK CONSTRUCTION.

Not only have new rails been laid for the electric system, but the streets have been repaved from curb to curb on all of the lines, with either asphalt or belgian blocks, this being one of the conditions under which the franchise was granted by the city government. Fig. 20 shows a general view of the street work, which is of the most approved character. The rails are 90-pound side-bearing,

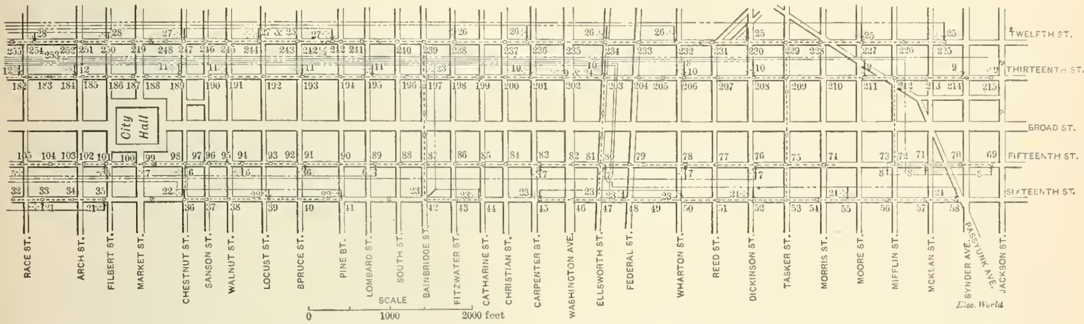


FIG. 19.—MAP OF SUBWAYS, FEED-CABLES AND MAN-HOLES 12TH AND 16TH STS. AND 13TH AND 15TH STS.—Continued.

together by means of the bolt shown. A hard rubber sleeve insulates the wire going to the trolley while leaving the pole. The whole is protected from rain by a cap and shield, and the trolley span wire is provided with extra heavy insulated turn buckles. Fig. 25 is a sketch of a typical feeder pole head.

The trolley wire is No. 0, B. & S., hard drawn copper, supported by hangers of moulded mica with soldered clips. The guard wires are No. 6 B. & S. silicon bronze and are placed 18 inches above the trolley wire and three feet apart, and are also steel, girder rails, $9\frac{1}{2}$ inches high, well spiked to ties laid in gravel. A feature of the track construction is the special rail work, crossings, turn-outs, frogs, etc., which is all integral work of special design and of a most substantial character. The rails and special work were furnished by Wm. Wharton, Jr., & Co.

The rails were laid with special care and the alignment is probably as good as it is possible to obtain. The gauge is 5 foot $2\frac{1}{4}$ inches.

All of the joints are lace-bonded with No. 0 B. & S. tinned cop-

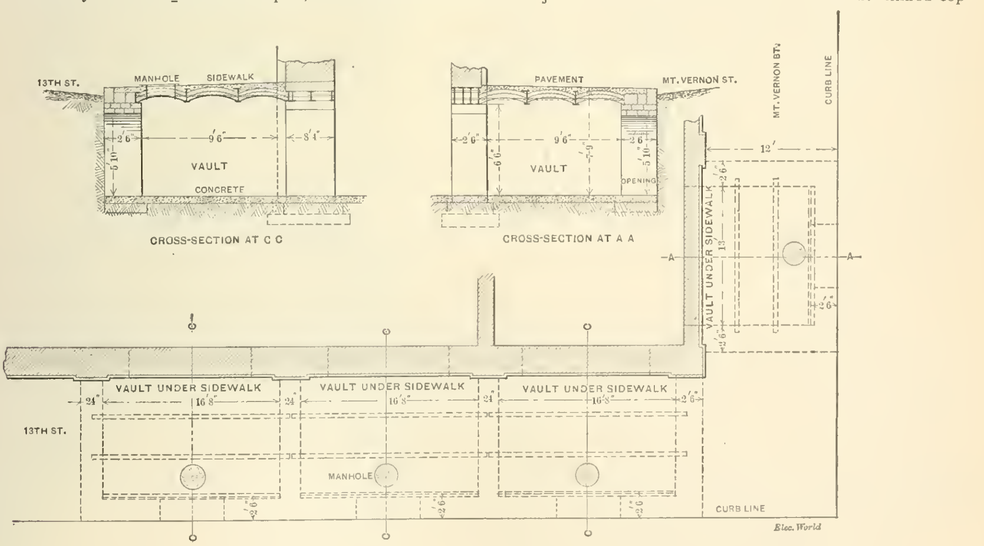


FIG. 21.—PLAN AND SECTION OF VAULTS UNDER SIDEWALKS, STATION B.

supported on insulated hangers. The span wires are No. 3, B. & S. silicon bronze, and are secured to the poles by the Brooklyn insulated turn buckle.

Section insulators are placed at intervals of from 1,000 to 4,000 feet according to circumstances. The sections can be connected through junction boxes, and no switches are used. The trolley wire is per wire fastened by channel pins, and the rails are cross-bonded every 60 to 90 feet. The joint next to the manhole is tied to the return feeder.

ROLLING STOCK AND CAR EQUIPMENT.

The cars for this system were built by J. G. Brill & Co., Philadelphia, Lamokin Car Works, Chester, Pa., and the LaClede Car Com-

pany, St. Louis, Mo., and are of the latest design and most substantial character. They are equipped mostly with Bemis trucks, but some have Brill maximum traction trucks. The Darby road cars (suburban) are 30 ft. long and have double trucks (Brill maximum traction trucks); the remainder are 16 and 18 ft. long, with single trucks. Fig. 26 is a dimension sketch of a typical closed car of

FIG. 20.—UNDERGROUND AND OVERHEAD CONSTRUCTION IN USE BY PHILADELPHIA TRACTION COMPANY.

this system. There are a few open cars with cross seats on one or two of the lines, but there are a large number of so-called "smoking cars," which are open cars with two seats in the middle, back to back, running lengthwise, and on any part of which passengers are permitted to smoke. There are altogether about 400 cars being operated on the system at present, but it is expected that this number will be doubled before long. The number of cars running on each line was given in Table II.*

There are at present ten car barns for the electric cars, as follows: 49th and Darby Road, 42nd and Chestnut streets, 44th and Girard avenue, Sutherland avenue and Christian street, Jackson and

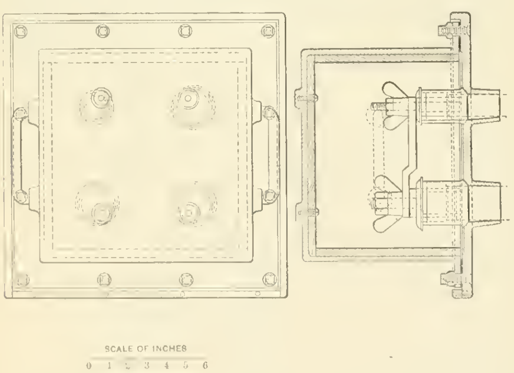


FIG. 24.—JUNCTION BOX USED IN THE VAULTS.

13th street, Wharton and 20th street, Cumberland and 15th street, Ridge avenue and 32nd street, Hancock and Lehigh streets, Gray's Ferry and 37th street.

The electrical equipment for the cars has all been furnished by the Westinghouse Company; most of the cars are equipped with two No. 3 25-hp motors, and the Darby Road cars (double truck, suburban) with two 30-hp motors, and D, E, and G controllers. In the heart of the city the cars are run on the 3rd notch of the controller

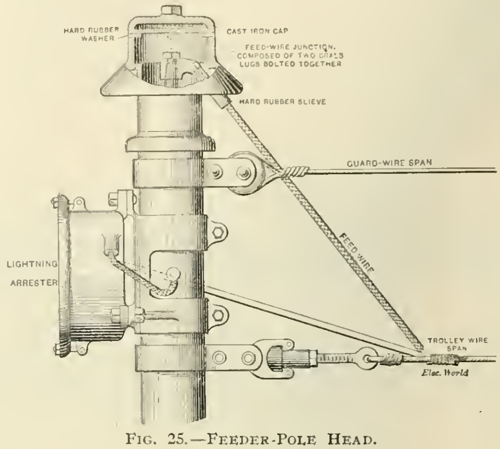


FIG. 25.—FEEDER-POLE HEAD.

(motors in series) owing to the crowded condition of the streets and the large number of stops required. Where the streets become freer, the 10th notch is usually used, but a high average speed can not be attained as the law requires the cars to be brought to a standstill at every street crossing. The average round trip speed is about 10 miles an hour, and the daily mileage is about 130. The cars are all

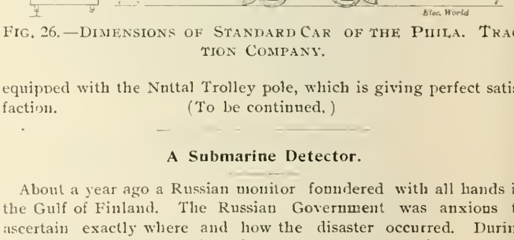


FIG. 26.—DIMENSIONS OF STANDARD CAR OF THE PHILA. TRACTION COMPANY.

equipped with the Nuttal Trolley pole, which is giving perfect satisfaction. (To be continued.)

A Submarine Detector.

About a year ago a Russian monitor foundered with all hands in the Gulf of Finland. The Russian Government was anxious to ascertain exactly where and how the disaster occurred. During the present summer a flotilla of boats has been patrolling the Gulf of Finland with a view of discovering the wreck. To increase the chance of the success of this search one of the boats was provided with a McEvoy electric submarine detector specially modified to meet the peculiar circumstances of the case, and a few weeks ago the unfortunate ship was localized by means of the detector in 30 fathoms of water, and divers were sent down to examine her. The McEvoy detector is designed on the principle of the Hughe's induction balance, and as used in this search it consisted of two primary coils conected in series with each other, a battery with a make and brake contact in the primary circuit, and two secondaries, wound in opposition, with a telephone placed in their circuit. The battery with the make and brake contact, one primary coil, one secondary coil, and the telephone were on deck, the rest of the apparatus being trailed along the bottom of the sea at depths ranging from 15 to 50 fathoms. When the search vessel passed over the wreck, the presence of the submerged ironclad was detected by the complete upsetting of the balance of the apparatus, which thus gave indubitable evidence of the presence of a large mass of magnetic metal. Capt. M'Evoy designed his detector primarily with a view of enabling those in charge of a system of submarine mines to detect the approach of a hostile ship; each mine having a secondary and primary coil, the rest of the apparatus on shore.

* See The Electrical World, Oct. 20, 1894, p. 384.

Light from Electric Oscillations.*

BY H. EBERT.

In recent times investigators have applied themselves with ever increasing interest to the problem of producing light by electric oscillations or alternate currents of high frequency, such as are obtained by condenser discharges. Only in a few isolated cases, however, have the arrangements fulfilled the necessary conditions for obtaining the maximum lighting effect from the given supply of energy. Furthermore, as far as known to the author, there have been no measurements made of the economy of lighting effected in this way. However brilliant the luminous effects obtained by Tesla may have been, it is only by measurements of the total energy expended to produce the lighting effect that we can hope to arrive at a conclusion as to whether an economical advance in the art of lighting is to be expected from this system. The author wishes to show that by observing the necessary conditions, considerable light effects can be obtained by very simple means from very long continued electrical movements of the kind just mentioned.

The conditions necessary for obtaining the maximum luminous effects by the influence of electric oscillations on rarefied gases, have been investigated by E. Wiedemann and the author by means of Lecher's parallel wire arrangement. In all cases the result was obtained, that the best effects could only be attained when the secondary circuit was exactly "tuned" to the primary discharging circuit. The oscillations in the secondary circuit must in fact be what is called in the theory of sound, resonant. It was found also that perfectly regular oscillations could be obtained only when air condensers were employed. When the Leyden jar, or any other condenser with solid dielectric was used, disturbances and irregularities were introduced by the well known residual actions that occur in these cases.

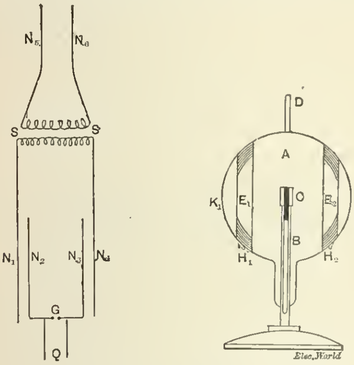


FIG. 1 AND 2.—DIAGRAM OF CONNECTIONS AND LUMINESCENT LAMP.

These, and similar experiments, show that to obtain luminous effects in a rational manner by means of electric oscillations or high frequency currents, we must—

Firstly.—Time the primary and secondary circuits exactly to one another. That is to say, the time of oscillation $T = 2\pi\sqrt{LC}$ must be the same, or in a simple harmonic relation for both circuits.

Secondly.—The capacity of the air or oil condensers in the circuits must be as small as possible in order to reduce the damping to a minimum. The logarithmic decrement of the electric oscillations is given by the expression $\pi R\sqrt{C/L}$ (R, the ohmic resistance; C, the capacity; and L, the self induction of the circuit). It appears from this expression that, as stated, C must be as small as possible, and L as large as possible for a given R; but the limit of increase of L is soon reached.

It is not necessary to use high tensions, since it has been found that intense light effects can be produced by the movement of exceedingly small quantities of electricity, provided only that the oscillations follow each other regularly and are persistent.

Keeping these considerations in view, a simple apparatus has been designed which has proved very effective for producing electric light by high frequency currents. The principle of the apparatus can be readily seen from the diagram of connections (Fig. 1). The current (from an influence machine, an induction coil, or a sufficiently highly transformed alternating current) coming in by the conductors, Q, charges the two condenser plates N_2 and N_3, which, thereupon, induce upon the plates N_1 and N_4, corresponding charges. When a spark passes at G, the charges heaped upon N_1 and N_4 equalize themselves, with oscillations, through the coil, S. Round this coil, S, is wound a similar coil connected to the plates, N_5 N_6, of the secondary condenser. Between these two plates is developed the high frequency field. Vacuum tubes or other objects to be acted upon may be introduced between the plates, N_5 and N_6 or they may be metallically connected to them by wires. There is thus no direct metallic connection between the primary and secondary circuits, but they mutually act upon one another by the lateral induction of the spirals. By changing the distance between the condenser plates, the two circuits can be tuned into exact unison with one another. By changing the capacity, by applying longer or shorter spirals, S, or by increasing or diminishing the length of the primary spark gap, or the number of the sparks, the conditions of the experiment can be indefinitely varied, and, more especially, the frequency of the oscillations can be varied within wide limits.

The condensers are simply made of couples of metal plates mounted so as to slide on glass rods passing through their centres. There is no danger of leakage along the glass rod, as the spark gap is only 2 to 3 mm in length. It is found to be much better to use many small sparks, provided they are regular and sharp, than long sparks.

With this apparatus, 20,000 oscillations will take place before the amplitude is damped down to the 2.7th part of the original value. If the number of sparks at G is sufficiently increased (and this can be done without a large supply of electricity on account of their shortness), the field between N_5 and N_6 may be kept in an almost uninterrupted state of oscillation.

Since everything in the wave apparatus is so adjusted that the activity of the oscillation is a maximum, only a very small exciter is necessary. Even a single plate influence machine serves to excite it, though, of course, the phenomena with a multiple plate machine are much more brilliant. A medium sized induction coil gives very fair luminous effects, but generally it is not so suitable as the influence machine, because the supply of electricity is not usually sufficiently regular.

The application of this resonant wave apparatus to the excitation of vacuum tubes, and to spectroscopic investigations at low temperatures, is described, but we give here only its application to the production of light. Wiedemann and the author had shown in previous investigations that regular, weakly damped, electrical oscillations possessed a very remarkable power of exciting cathode rays of great intensity, which have a remarkably great capacity of producing fluorescence or phosphorescence, or to speak generally, luminescence, with very small expenditure of energy.

Even with very small sparks and amounts of energy on the secondary condenser, these cathode effects attain, when everything is properly tuned, an intensity which is quite comparable with that obtained by using large alternating generators. If a suitable phosphorescent substance is exposed to these rays, it will emit a considerable amount of light. Even when powerful alternating currents are employed to excite the phosphorescence, scarcely any heat is produced. A lamp is thus obtained which emits almost only visible rays, without development of heat, and consequently the amount of energy which the lamp consumes is enormously small.

A simple, but very economical "luminescent lamp" may be constructed by fusing the glass tube, B, Fig. 2, in the glass bulb, A, closing it at the lower end, and fixing a disc, C, of compressed luminous paint (Leuchtfarbe) by a wire at the top. The bulb is then exhausted by the tube D, and closed. Two strips of tinfoil, E_1 and E_2, are glued on, and furnished with hooks, H_1, H_2 to which the condenser plates, N_5, N_6, of the wave apparatus are connected. When the electric oscillations act upon the coatings, E_1, E_2, active cathode rays are formed on the inner surface and perpendicular to it. These rays, though almost invisible themselves, produce a strong luminescent light upon the surface of the luminous paint on which they converge, and the light radiates out through the transparent ends, K_1, K_2, of the bulb.

A series of preliminary experiments were made to determine the efficiency of the "luminescent lamp." The candle power was found to be about one-thirtieth to one-fortieth of the amyl acetate standard, which is approximately equal to the standard candle in this country. The energy expended being difficult to measure directly, was calculated from the capacity and potential of the secondary circuit. It was found that the energy actually expended in producing the light was about one-millionth part of a watt. By

*From the London *Electrical Review*. Summarized from *Wied. Ann.*, Vol. liii., p. 144.

comparing the brightness of this lamp in the visible part with that of the amyl acetate lamp, and calculating for both the *total* energy consumed in their maintenance, it was found that the high frequency lamp consumed from 1,500 to 2,000 times less energy than the amyl acetate standard. One difficulty in the way of the practical application of the high frequency lamp is that the high frequency currents could not be carried to great distance even in a straight cable, on account of the reactance which self-induction would oppose to such rapid oscillations; but the difficulty may to a certain extent be overcome by effecting the transformation to high frequency at the lamps. Since only condensers of small capacity, and small inductances are required, a simple and very compendious apparatus of the kind described could be combined with the lamp.

The economy of all arrangements which were not perfectly tuned as above explained, was found to be much less.

Electrodynamic Machinery—XIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

69. When a conducting wire is moved through a magnetic flux, there will always be an E. M. F. induced in the wire, unless the motion of the wire coincides with the direction of the flux, or, in other words, unless the wire in its motion does not pass through or cut the flux. Thus, if, as in Fig. 50, a straight wire A B, of l cms length, extending across a uniform flux, be moved at right angles to the flux, either upwards or downwards, for example, to the position a b, or a′ b′, it will have an E. M. F. induced in it, the direction of which will change with the direction of the motion.

70. A convenient rule for memorizing the direction of the E. M. F. induced in a wire cutting, or moving across magnetic flux, is known as Fleming's hand rule, illustrated by the *right* hand in Fig. 51. Here the thu*m*b indicates the direction of motion, the *f*orefinger

FIG. 51.

the direction of the magnetic flux, and the *m*iddle finger the direction of induced E. *M.* F. For example, if, as in Fig. 50, a wire be moved vertically downwards from A B to a′ b′, and the thumb be held in that direction, the forefinger pointing in the direction of the flux, the E. M. F. induced in the wire will take the direction a′ b′, during the motion, following the direction of the middle finger. If, however, the wire be moved upwards through the flux, application of the same rule will show that the direction of the induced E. M. F., *i.e.*, of the middle finger, is now changed.

71. The induction of electromotive force in a conductor, moving so as to pass through or cut magnetic flux, is called *electrodynamic induction*. The value of the E. M. F. induced in a wire by electrodynamic induction depends on the density of the magnetic flux, the velocity of the motion, and the length of the wire. This is equivalent to the statement that the E. M. F., induced in a given length of wire, depends upon the total amount of flux cut through by the wire in the same direction per second; or,

$$e = \mathfrak{B}\, l\, v \text{ C. G. S. units of E. M. F.}$$

Where $\mathfrak{B}$, is the intensity of the flux in gausses, l, the length of the conductor in cms, v, the velocity of motion in cms per second, and e, the induced electromotive force as measured in C. G. S. units. One international volt is equal to 100,000,000 C. G. S. units of E. M. F., so that the E. M. F. induced in the wire will be

$$e = \frac{l\, v}{100{,}000{,}000} \text{ volts.}$$

72. The preceding equation implies the supposition that the wire is not only lying at right angles to the flux, but also that it is moved in a direction at right angles to the direction of the flux. If the wire, instead of being at right angles to the flux, makes an angle β, with the perpendicular to the same, as shown in Fig. 52, then the length of the wire has to be considered as the vertical length across

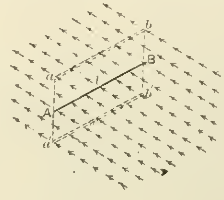


FIG. 50.

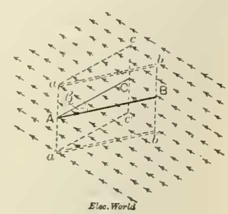


FIG. 52.

the flux, or its projection on the normal plane, so that the formula becomes,

$$e = \frac{\mathfrak{B}\, l\, v \cos \beta}{100{,}000{,}000} \text{ volts.}$$

If also the motion of the wire, instead of being directed perpendicularly to the flux, is such as to make an angle α, with the perpendicular plane, the effective velocity is that virtually taking place perpendicular to the flux, or $v \cos \alpha$, as shown in Fig. 53, so that the formula becomes in the most general case,

$$e = \frac{\mathfrak{B}\, l \cos \beta \,.\, v \cos \alpha}{100{,}000{,}000} \text{ volts}$$

It will be seen that in all cases the amount of flux cut through in one second, gives the value of the E. M. F. induced in the wire, and that the value of the E. M. F. does not depend upon the amount of flux that has been cut through, or that has to be cut through, but upon the instantaneous rate of cutting, and that the E. M. F. ceases the moment the cutting ceases.

73. If the loop A B C D, Fig. 54, be rotated about its axis OO′, and in the direction of the arrows, then, while the side C D, is ascending, the side A B, is descending; consequently the direction of the E. M. F. in the side C D will be oppositely directed to the E. M. F. in the side A B. Applying Fleming's hand rule to this case, we observe that the direction of these E. M. F's. are as indicated by the double-headed arrows, which, regarding the conductors C D and A B, as forming parts of the complete circuit C D A B, it is evident that the E. M. F's. induced in A B and C D, will aid each other, and, that if they are permitted to produce a current, the current will flow through the circuit in one and the same direction.

74. We have seen that no E. M. F. is induced in a wire unless it cuts through flux, consequently the portions B C and A D, of the circuit which move in the plane of the flux, will contribute nothing to the E. M. F. of the circuit.

If the dimensions of the wires forming this loop shown in the figure, are such that C D and A B, having each a length of 12

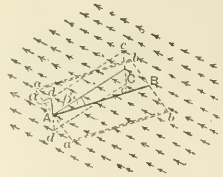


FIG. 53.

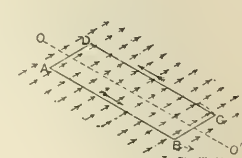


FIG. 54.

cms, while A B and B C, are 4 cms each, the circumference traced by the wires A B and C D, in their revolution about the axis, will be 3.1416 × 4 = 12.567; and, if the rate of rotation be 50 revolutions per second, the speed with which the wires A B and C D, revolve will be 628.3 cms per second. If the intensity of the magnetic flux, $\mathfrak{B}$, is uniformly 5 kilogausses, the E. M. F. induced in each of the wires A B and C D, will be, 5,000 × 12 × 628.32 = 37,699,200 C. G. S. units of E. M. F., or 0.377 volt. This value

of the E. M. F. only exists at the instant when the loop has its plane coincident to the plane of the flux, and the sides cut the flux at right angles. In any other position the motion of these sides is not at right angles to the flux.

(To be continued).

A Dresden Electric Plant.

BY ROBERT GRIMSHAW.

One of the most interesting electric lighting plants in Continental Europe is that just completed in part in Friedrichstadt, Dresden, for the use of the government railways, under the supervision and from the plans of Prof. Dr. Ulbricht of the Royal Technical High School (Polytechnikum), Dresden.

The installation being one for the conversion of mechanical force into electrical energy, it is perhaps proper that the power generating department be first described. The general position of the plant with relation to the depots and tracks to be served and to the Elbe river may be seen in Fig. 1. A general view of the main building is shown in Fig. 2.

The boiler-house is a parallelogram 29 by 16 meters in plan and 8 metres high, with a trussed roof, and is intended to contain 6 compound boilers, of which there are already installed two (one serving as a reserve). Each of these is of the "two-story" type, consisting below of one horizontal cylinder 4.95 metres long and 2.0 metres in external diameter, and having 2 flues 4.95 metres long and 0.8 metres in diameter, and above of one horizontal cylinder 3.5 metres long and 2.13 metres in diameter, with 100 iron tubes, each 3.5 metres long and 0.09 metres internal diameter. The main shells are of wrought iron 16 to 20 mm. in thickness, and the system is tested to a pressure of 13 atmospheres by the gauge, the working pressure being 8 atmospheres by the gauge. The grates are inclined and steeped, and each has an area of $2 \times 1.5 = 3$ m². The fuel burned is soft Bohemian free-burning coal (gives about 4 kg of steam per kg coal) burning without coking or clinkering. The combustion gases after passing through the large flues below, reverse their course under the upper cylinders, and then pass through the flues to the stack. The entire heating surface of each double-deck boiler is 150

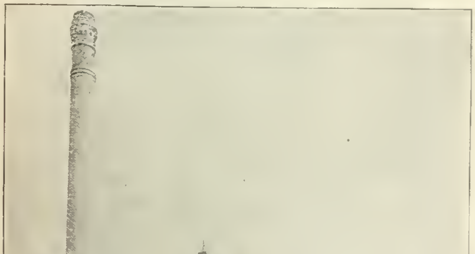


Fig. 2.—View of Main Building.

square meters, giving a proportion of heating surface to grate surface of 50 to 1.

The feeding is by injectors, and an automatic device ensures that the water level in the upper shells (it is understood that there is steam space in both the lower and the upper story of each boiler) shall be kept constant and that the upper shells shall receive feed before the lower ones; that is, should there be low water, by any mischance, it will occur in the lower shells first. The glass water gauges are protected by semi-cylindrical shields of tough glass 10 mm in thickness, enclosing in its substance a strong wire netting—so that should the gauge glass break, the fireman will be protected by the strengthened shield while he closes the cocks communicating between the gauge glass and the boiler. There is a pointer to indicate the proper water level to be maintained in each shell.

The stack stands apart from the boiler-house, and is a handsome

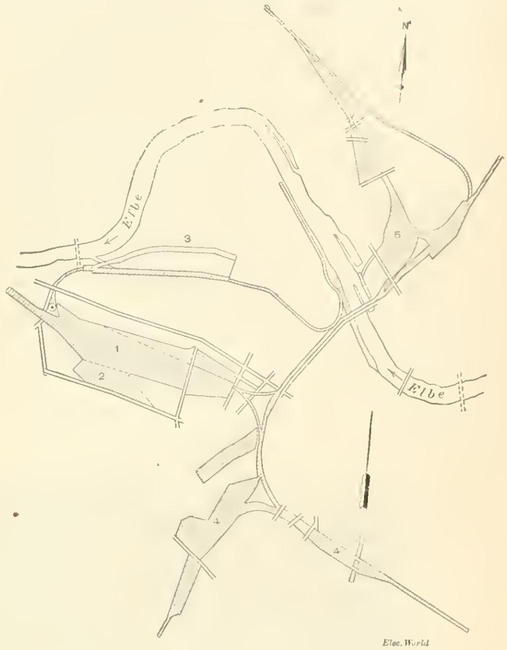


Fig. 1.—Map of Territory Supplied.

structure of yellow brick, 60 meters high, but from its fine proportions appearing much less. It is circular in plan, with a broad base; the flue is 2.9 metres in diameter at the base, and 2.6 metres at the top; the outer diameter of the shaft proper tapers from 4.5 metres at a distance of 16 metres from the ground to 3.25 just under the cap mouldings.

With the present slight demand for steam, the evaporation is only 1,480 kg of water per hour; this being accomplished from feed water at 10 degrees centigrade, with a fuel consumption of 1,500-kg without the water for combustion. The feed water is obtained from the usual supply for the city of Dresden, and contains but a slight amount of impurities, as it is derived from the sandstone strata which characterizes this part of Saxony. The supply pipes which lead from these boilers to the engines are of wrought iron with gentle curves instead of the usual cast iron "ells" and are covered with a non-conductor of heat.

The setting of the boilers is of brick. The ashes are removed by cars. All that portion of the boiler-house floor which constitutes the foot-way in front of the boilers (a strip 3.7 metres wide) is floored with tiles, giving a every neat finish. The coal is drawn from bins outside the boiler-house proper, but built against its walls, and is withdrawn through closely fitting iron doors, one in front of each boiler, so that the house remains neat and sightly.

The engine-room is also the dynamo-room. It is 44 metres long, 17 wide, and 10 high, with a gallery stretching across one end for the switchboards, ampere metres, etc. The roof is open and trussed. An overhead traveling crane permits handling the heaviest pieces with ease and convenience.

There will be eventually four engines, of say, 600 total hp; but at present there are but two, of which one is a reserve. These are directly connected to the dynamos. Each is a horizontal tandem compound condensing engine of a modified Proell drop cut-off type. The high pressure cylinder is 450 mm diameter, and the low pressure cylinder 750 mm, the stroke being .9 metre. There is a back rod to ensure stiffness and alignment of the pistons. The frames are of the girder type. The admission valves are vertical poppets on top; those of the high pressure cylinder being controlled

by the governor and those of the low being variable in admission period only by hand adjustment. The exhaust valves of both cylinders are plain slides, one for each end, and are underneath the cylinders so as to ensure good drainage.

The engines make 100 turns a minute, giving a piston speed of 180 metres per minute. The condensers are of the jet type, the circulating water being drawn from a masonry lined, stone bottomed pond constructed in the grounds of the plant for this purpose, and of a capacity of 4,000 cubic metres of water drawn from a well 4 metres in diameter and 15 metres deep, communicating through underground strata with the river Elbe, about 500 metres distant. The temperature of the water in this pond varies but sligthly from 25° C. At present, working 160-hp during nine hours of the night run, it is raised but 2° C.

An electric motor governor, adjustable from the switchboard, permits varying the engine speed at will. As the exciting dynamo of each main armature serves both armatures and the currents from both main armatures are joined before going to the converters, the engines must keep absolute time with each other.

With the cut-off in the high pressure cylinder at 0.28 stroke, and an initial pressure of 7.5 kilograms per square centimetre at the cylinder, each engine develops at 100 rotations per minute, and with a vacuum of 0.7 kilograms per square centimetre relative to absolute zero, 366 gross indicated horse-power, which amounts to 300 horse-power net, by the brake, (when the friction of the engines themselves and of the direct connected main and exciting armatures are deducted) to be converted into electrical energy. The output is 200,000 watts, showing an electrical efficiency of about 90 per cent.

The machines generate three-phased currents which leave the dynamo at a voltage of 120, which is increased in the incandescent with 74; the arc light takes the current between the first and second and between the second and third wires, and the incandescent between the first and third.

Fig. 4 shows the division of the currents for lamps and motors; the lamps taking the difference between the first and third leads only; the motors taking that between the first and second and the third.

There is a Thomson electrostatic indicator to show if a ground connection occurs with each wire.

The cables carrying the current are triple, each having three 7-wire conductors, with gutta-percha between; then a lead pipe,

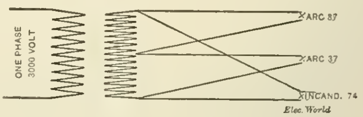


Fig. 4.—Transformer Connections.

then insulating and water-proofing composition, and then iron tape. The copper in the conductors will weigh about 40,000 kg.

The entire system of engines and dynamos is insulated electrically from the ground. The tension between the wires of the triple lead system is 3,000 volts; that between the wires and the ground 2,000.

Under the triple lead conductors there is stretched a network of two stout parallel wires connected at short intervals by wire crosspieces, so that should a conducting wire break it would most probably fall on this network and be prevented from doing damages, as the circuit would be completed through this. Should an end project through the network, and come in contact with a person, the

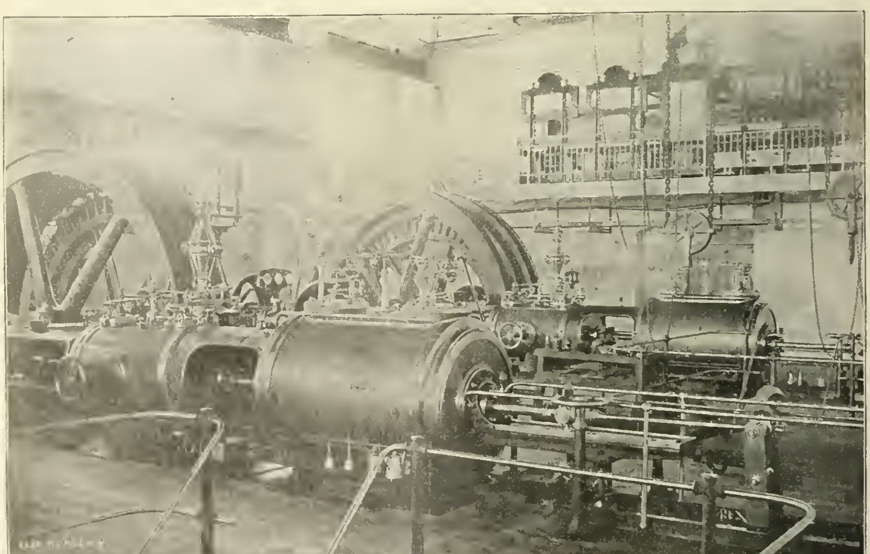


Fig. 3.—Engine and Dynamo Room.

converters to 3,000. Each dynamo is coupled with a continuous current exciting machine of 20,000 watts capacity; but the two three-phase machines are coupled together and the two continuous current machines also. The exciting current is of 110 volts tension.

There are at present three converters of the Siemens vertical type; there is space in the converter room for 15, and present provision has been made for the installation of nine. The transformers are in a room 8.2 × 14.25 metres square; they are insulated from the earth.

The maximum of energy now generated (October, 1894), amounts to but 100,000 watts, of which 80,000 watts are used for arc lights and 20,000 for incandescent lights. Eventually next year the current output will be 600,000 watts, of which 350,000 will be for arc-lights, 150,000 for incandescent lights and 100,000 for stationary motors. The arc lights are run with a voltage of 37 and the chances of the latter getting any but a very slight amount of current would be infinitesimal.

There will be required about 800 arc-lamps with 200 to 840 watts consumption, 3,600 incandescent lights and about 350-horse power for motors; but of these last not all will be required at once.

The distribution of current is shown in Fig. 1, in which there are five sections; No. 1 for the switching depot, No. 2 for the workshops, No. 3 for the dock department, No. 4 for the main depot, and No. 5 for Newstadt. The entire demand for all five will be about 600,000 watts, of which a quarter will be needed for motors in the workshops, for cranes, track, etc. The district to be served is about ¼ of a million square metres; of which 4 per cent. is for depot and other platforms, and 12 per cent. for closed buildings. The greatest distance of service is 6 kilometres, the average is little over two kilometres.

Cost of Light and Power for the California Midwinter International Exposition.

BY W. F. C. HASSON AND A. M. HUNT.

The following data concerning the California Exposition and the expense connected with furnishing the necessary light and power may be of interest.

The exposition was located in a partially improved portion of Golden Gate Park. Three-fourths of the ground consisted of sand hills on which were a few clumps of evergreens and a grove of young eucalyptus trees The remaining fourth was swamp land, and was afterwards converted into a recreation ground and plaza for fireworks and athletic and equestrian entertainments.

The citizens of San Francisco contributed $331,000 to the Expositon fund. The original concession from the Park Commissioners was less than sixty acres. This grew to one hundred and sixty acres without a corresponding increase in subscriptions. Notwithstanding the fact that the Exposition had no aid from the general government, state, county or city, not only were all obligations met, but a sufficient surplus remained to leave a large portion of the park permanently improved, and also a public museum and art gallery.

The distance from the dynamo to the electric fountain was 460 ft. and to carry the current for the fountain lights, ten 4-0 cables were necessary. The distance from the dynamo to the base of the electric tower was 680 ft., and to carry the current for the tower lights, twelve 4-0 cables were used. Minute economy in every department was necessary, and expensive underground ducts were therefore out of the question. The duct for these underground cables was built of ordinary planks, the outside dimensions being 6 inches by 4 inches, and the inside 4 inches by 2 inches. A continuous strip of P. &. B. roofing paper was laid the entire length of the duct, the cables placed in position, the paper folded over, and both edges finally secured in position by the cover of the duct. Although a large portion of the duct was under a lawn continuously saturated with water, no trouble whatsoever arose from this source. A large portion of the wire used was 4-0 cable that had been in use at the World's Fair. This wire on removal was found to be in such excellent condition that it has been sold for interior wiring for 60 per cent. of its original cost.

The ducts for underground wires for arc lights consisted of 2 inches by 4 inches rough lumber in which there was a 1 inch by 1 inch rabbet.

Lamp poles were turned 8 inches diameter at base and 5 inches at top; height 12 feet to 14 feet. Wires were carried in a groove that was closed with a fillet. Around the Grand Court, arc lamps were spaced 30 feet and 35 feet. On roadways, 50 feet and 75 feet.

For cornice lighting a 500-volt Edison railway generator was used. Lamps were wired in series of five and multiples of ten where the construction of the building would permit.

Edison lamps were the ones used throughout. The wiring was so arranged that the lamps on buildings nearest the power station were 117 volts; those half way around the court 115 volts; and those most distant, 113 volts.

For all accessible places 16-cp lamps were used. For places difficult of access; on domes and minarets, 20 and 24-cp, 120 volt lamps were used. This policy proved to be an excellent one, as the renewals in these places were merely nominal.

The wiring for the cornice lights was done by contract by the General Electric Company. The sockets were in place several days before the lamps were placed in position, and through the carelessness of the inspector of wiring a great number of lamps were allowed to be placed in sockets partially filled with water. The first test of the decorative cornice lighting resulted in a dismal failure. The lamps were then removed, the sockets cleaned, and new lamps placed in position. Satisfactory results were obtained for a few days. When, after a heavy fog, a large number of lamps were found to be inoperative, examination showed that in many cases the leading-in wires had been destroyed by electrolytic action. Lamps that were found to be in good condition were then thoroughly dried at a temperature of 300 degrees F, and the bases immersed in a bath of boiling paraffine. These lamps when placed in use withstood the weather perfectly, and the number of renewals became nominal.

The construction work of the Electrical Department, briefly stated, was as follows:

Length of underground circuits installed	17,500 feet
Length of main pole line constructed	9,000 feet
Lamp poles for roadways	371
Incandescent lamps—wiring for	1,800
Total length of wire installed	199,267 feet

The construction work of the Mechanical Department consisted of the unloading and handling of all machinery, the erection of all engines except two, the hanging of all shafting, the supervision of installation of all boilers, piping and pumps for fountains, &c.

The Mechanical Arts Building was so poorly designed for the purpose for which it was used that considerable labor and expense was necessary to put it in proper condition.

The Chief of the Engineering Department was also Chief of the Department of Mechanical Arts, which added greatly to the office expenses of that Department.

Following is some data relating to the Exposition grounds and structures:

Area enclosed in the Exposition grounds	160 acres
Length of roadways	12,500 feet
Number of buildings	120
Buildings supplied with electric light	63
Height of Electric Tower	262 feet
Dimensions of Grand Court	1,000x500 "

The power furnished for Exposition purposes was as follows:

56 arc lights Mechanics Arts Building.
141 " " Manufacturers and Liberal Arts Building.
112 " " Horticultural and Agricultural.
98 " " Grand Court.
160 " " roadways, etc.
42 " " patrol circuit.
1,788 incandescent lights Exposition buildings and offices.
2,256 " " cornice lights.
3,213 " " Electric Tower.
1 60-inch search light on Electric Tower.
1 30-inch " " for Mechanics Arts Building.
19 small " " for Electric Fountain
3 pumps for electric fountain.
2 " " Statuary "
Line shafting.
Fire pumps.

Incandescent lights furnished to the Exposition	7,256
" " sold	1,876
Total incandescent lights	9,132

Ratio of total lights to lights sold, 4.86 : 1.

Arc lights furnished to the Exposition	609
" " sold	182
Total arc lights	791

Ratio of total lights to lights sold, 4.34 : 1.

Receipts for sale of light and power	$26,279 00

The machinery used for supplying power was as follows:

8 Heine boilers of 375-hp each.
1 Russell engine driving four 50-light T.-H. arc dynamos.
1 Buckeye " " four " " " "
1 Payne " " one " Standard arc dynamos.
1 N. Y. Safety " one " Wood " "
one 60-light " " "
1 Ohmen " " three 50-light Standard " "
1 Ball " " two " Western Electric arc dynamos.
1 Thompson " " one " " " " "
1 Taylor-Beck " one " " " " "
1 Hamilton-Corliss engine driving one 300-kw T.-H. A. C. generator.
1 Pitchford " " " " 150-kw Wood " "
1 Union Iron Works engine driving two 150-kw Western Electric D. C. generators.
1 Thompson-Corliss engine driving one 150-kw Edison D. C. generator.
1 Hendy engine driving one 200-kw Edison railway generator.
1 Putnam engine driving two centrifugal pumps for statuary fountain.
2 Hendy " " shafting.
3 Dow fire pumps.
3 Dow pumps for electric fountain.
3 Dow feed pumps.
1 Smith-Vaile feed pump.
1 4,000-hp Webster vacuum heater.

The cost of material and labor for the installation of the machinery was as follows:

Erection of boilers, pipes, pipe-covering, etc	$17,594 33
Concrete foundation and foundation bolts for 14 engines and 6 pumps	4,459 09
Belting, shafting and sundries	2,605 89
Riggers	573 00
Office, wages and pay roll	3,787 19
Total	$29,019 50

The cost of labor, material, etc., for fountains was as follows:

Electric Fountain:	
Total expense for rental and installation of pumps, purchase and laying of pipes, all pump connections, and construction of flume and tank	$13,692 72
Statuary Fountain:	
Total expense for pipes, connections, etc	1,659 89
	$15,352 61
Wiring:	
Three main buildings for 307 arc lights	990 90
For 2,160 exterior and 1,587 interior incandescent lights	3,997 00
	$4,987 90
Rentals:	
Paid for use of boilers, engines, dynamos, wire pole-hoods, etc	$17,528 20

The cost of material and labor for the installation of the electric plant was as follows:

Wire	$6,056 92	
Sundry materials	2,701 58	
Foundations for dynamos	593 47	
Office, wages, salaries, etc	5 709 40	
		$15,061 37

The following was provided for by special contract:

Electric Fountain:	
Contract for erection, rental and operation of same except splash basins, piping, pumps, etc., included in other statements	$21,000 00

[illegible]		
Contract for rental of machinery, wiring of tower, operation of machinery and maintenance of lamps		22,745 00
Search Light :		
Erection of search light	$87 50	
Material for operation	67 05	
		$154 55

The cost of operation of the plant from January 27th to July 9th, 1894, was as follows :

Engines and Boilers :		
Coal, fuel and lubricating oil	$30,007 95	
Tools, supplies and repairs	1,886 93	
Office, salaries and payroll, including all expenses for office, janitors, etc., connected with Mechanics Arts Building	13,680 50	
	$45,575 38	
Electric Plant :		
Carbons	$1,513 50	
Incandescent lamps	2,072 20	
Tools, supplies, etc	987 61	
		$4,573 31
Salaries :		
Office	$717 00	
Inspection	359 33	
Wages	9,257 05	
		10,333 38
		$14,906 69

The total expense of installation and operation was as follows :

Installation of engine plant	$29,019 50
Erection of fountains	15,352 61
Wiring contracts	4,987 90
Rentals	17,528 20
Installation of electric plant	15,061 37
Operation of engines and boilers	45,575 38
" " electric plant	14,906 69
Contract electric fountain	21,000 00
" " tower	22,745 00
Expense for search lights	154 55
	$186,331 20

The average daily load during the month of June was distributed as follows :

Arc light machines	2,156	horse-power	hours
A. C. incandescent machines	2,462	"	"
Electric Fountain generator	2,805	"	"
Railway generator, light and power	2,770	"	"
Generators for Electric Tower lights	810	"	"
Fountain pumps, electric	233	"	"
" " statuary	480	"	"
Fire pumps	600	"	"
Feed	442	"	"
Shafting	160	"	"
Starting	110	"	"
Total daily load	13,026	"	"

Gallons of oil consumed per month	130,200
" " " " " day	4,340
Weight of oil " " "	32,116 lbs
" " " " " hp hour	2.465 lbs
Cost per lb of oil at $1 75 per bbl	.56 cts.
" " indicated horse-power per hour of engines	1.3804 cts.
Percentage of load for incandescent lights	28.2 per cent
Cost of fuel for incandescent lighting per month	$1,520 99
Cost of fuel per incandescent lamp per month	16.5 cts.
Charges per incandescent lamp—period of Exposition	$8 00
" " arc " " " "	75 00
Period of operation, January 27th to July 9th, 1894:	
Hours of incandescent light service	1,937
Days of arc light service	154
Number of Electric Fountain displays	252

The cost per 16-cp lamp for the period of the Exposition was as follows :

Freight on electric machinery	$ .40
Installation of dynamos	.05
Attendance of dynamos	.21
Installation of wiring	1.20
Inspection of wiring	.05
Patrol and maintenance of circuits	.03
Lamps and renewals	.30
Office expenses, Electrical Department	.06
Total, Electric Department	$2.30
Installation, engines, boilers, piping, belting and rentals	$1.32
Fuel	.825
Attendance, engines, boilers and pumps	.285
Oil, waste, etc	.01
Office expenses, Engineering Department	.05
Total, Engineering Department	$2.49

The total expense therefore, of rental, installation, operation and maintenance of boilers, engines, piping, belting, dynamos, wiring, lamps, etc., per 16-cp incandescent lamp for the period of the Exposition, was $4.79.

In considering the cost of operation, it must be borne in mind that the lighting plant was in no sense well designed for economic operation. Both engines and dynamos were operative exhibits that had to be matched as well as circumstances would allow.

The installation of all parts of the plant was attended with undue expense, on account of the chaotic condition of affairs incident to the necessarily rapid construction work of all departments of the Exposition.

The entire plant was of necessity regarded as an emergency plant, and so operated. The economic attendance of dynamos and engines was thus out of question.

In making the preliminary estimates of the allowance to be made for cost of lighting plant, it was found impossible to get any figures of a plant under similar conditions except the contract for lighting the World's Fair.

The results given in this article are those that were actually obtained, and it would appear that they should be of value in estimating the probable cost of work of similar nature.

It is now certain that if all construction work had been done by the Exposition forces, the cost of construction would have been reduced about thirty-five per cent.

The Best Method of Treating Accidents.*

BY P. M. DYER.

It is my purpose to explain to you in what manner the North and West Chicago Street Railway Companies attend to personal injury cases, commencing with the accident and following the theme to the final disposition of the claim. These two corporations carried 167,000,000 passengers during the year ending December 31, 1893, and upon the claim department devolves the duty of investigating all accidents and the making of settlements, or preparation of the defence, in all claims that spring from this great traffic. One claim department does this work for both roads.

The working force consists of a medical staff and a sufficient number of investigators, all under the direction of the chief adjuster, who reports to the general counsel of the two companies. For the purpose of this article the work of the claim department may be divided into three periods, each separate and distinct from the others, as follows: First, investigation; second, negotiation; third, litigation.

First, as to investigation. The work of this period begins immediately after the accident and continues until there has been secured a full and accurate account of the accident, with reliable information as to the nature and extent of the injuries to person. Employees have been instructed to notify the claim department of the occurrence of an accident on car or train, giving circumstances of the same, nature of injuries to and residence of the injured, and as far as possible to secure the names of the witnesses. When this has been accomplished and the injured one has been placed in the charge of a physician or the police, the car or train may continue its journey. In the meantime a representative of the claim department will proceed with all possible dispatch to the scene of the accident. If the injured person has not yet been removed, he must see that conveyance is provided to the hospital or to the home.

These companies usually bear the expense of temporary medical care and transportation, without regard to liability, believing such attention is appreciated by the injured and the community at large. In all cases of personal injuries, it is the duty of the medical staff to secure the privilege of an examination; the physician making the same to avoid any assumption of responsibility for the treatment but to fully ascertain the nature and extent of the injuries, and to obtain, if possible, a concurrence in his report by the attending physician.

All employees witnessing accidents are required to make written statements of the circumstances of the same on printed forms provided for that purpose, attaching the names and places of residence of all witnesses. This report must be completed and given to the foreman before the employee finishes his day's duties. These reports are forwarded to the claim department without delay, and when received, circular letters containing printed interrogatories are sent to each witness. If the seriousness of the accident demands it, interviews are had with the witnesses. That the claim department may be kept fully advised from time to time as to the condition of persons injured on these roads, they are occasionally visited during the period of recovery by the investigators assigned to those cases. In Chicago all hearings before the coroner are had immediately after the accident, and the verdict of the coroner's jury is usually rendered on the day following the death. It is the policy of these companies to secure the presence of their witnesses at the hearing before the coroner, and obtain stenographic minutes of the proceedings. Thus, in a comparatively short time, the claim department will have collected much information as to the condition of the injured and the circumstances of the accident. We may now consider the work of the first period completed.

The reports relating to an accident could now be filed away, perhaps forever, if it were not for the industry of some claim lawyer or other hustler who persuades the injured to make a demand on the company for compensation. The making of a claim leads us to a consideration of the second period, that of negotiation. Demand being made for compensation, it becomes the duty of the chief

* A paper, slightly condensed, presented at the Atlanta meeting of the American Street Railway Association.

adjuster to place before the general manager or general counsel all facts within his knowledge bearing on the claim, for a decision as to liability, and the naming of the maximum sum to be paid, if a settlement is deemed advisable, the claimant being promptly informed of the decision. As to the negotiations preceding a settlement, I need say but little. They are usually conducted by the chief adjuster on the part of the company. If not successful the period of negotiation will end, usually to be followed by litigation, the third and last.

After the commencement of suit all witnesses are again located by the claim department, and thereafter located at stated intervals until the time of the trial, and if possible additional witnesses are found to strengthen the defense. Success in defending suits arising from personal injuries, largely depends on the character of the work done during the period of investigation. The officers of these companies believe in the thorough investigation of all accidents, if possible the settlement on a reasonable basis of all valid claims, in vigorously contesting fraudulent demands, and that prompt settlements are for the best interests of their companies.

In conclusion, I will say that the time is at hand when all railroad corporations must be prepared to resist claims in a large percentage of their accidents. To promptly prepare to do this is the part of wisdom, when considered from a financial standpoint, usually the determining consideration in corporate management.

Power-Brakes vs. Hand-Brakes.

In a paper on the above subject, read at the Atlanta Convention by Mr. E. J. Wessels, the inadequacy of the hand-brake for street railway work is strongly insisted upon, particularly on roads with grades. Duplicate hand-brakes, sometimes fitted where there are heavy grades, are condemned, owing to the wear and tear on apparatus, short life of shoes and retardation of speed.

It is stated that the braking force requisite to bring a car or train to a stop, should never exceed the weight of load resting upon the wheels to which brakes are applied. Any power applied in excess of this is wasteful and dangerous. The full power of a friction brake depends upon the load carried on axle to which friction discs are attached. For example, with grip car and passengers weighing 8,000 pounds, the weight being equally divided between two axles, 4,000 pounds are carried by the axle with friction discs. With car wheels of two and one-half times the diameter of the friction drum, that much leverage is gained, which, multiplied by 4,000 pounds, gives 10,000 pounds as the direct pull power of the friction brake. The brake levers of street cars are as a rule adjusted to about four and one-half times leverage. If, then, the 10,000 pounds pull of friction brake is multiplied by this leverage there is a strain of 45,000 pounds upon the brake beam and shoes. This is vastly more power than is ever required. When two or more cars are coupled together it is impossible to regulate brake chains and brake gear so that every shoe will press with equal force against the wheel. When, therefore, a gripman applies a friction brake, the entire 45,000 pounds is carried by the beam and shoe that are adjusted nearest the wheels and the remaining wheels revolve without noticeable check.

In a train of three four-wheeled cars with passengers, weighing 36,000 pounds, resting on twelve wheels, a brake power of say 2,900 pounds applied to each wheel would make the most perfect stop. If the entire 45,000 pounds power of friction-brake is applied to only two wheels of such a train, there will be 38,000 pounds more power exerted than necessary to stop the wheels from revolving, and at the same time only one-sixth effectual braking power is obtained as compared with a braking pressure distributed against every wheel under the train. Such harsh, rigid, excessive power of the friction brake, applied quickly by the momentum of the whole train, will wear out any kind of brake gear, no matter how good or how strongly made, and the constant jar adversely affects the life of cars. In cold, wet and stormy weather (with slippery tracks), when the grip car is abandoned except by the gripman, the pull power of the friction drum is greatly reduced just at the time it is most needed to set brakes on trailers, which are always overcrowded at such times. A twenty-eight foot closed electric car weighing, without passengers, 20,000 pounds, and running at ten miles per hour, has over six times the energy to overcome when brakes are applied that a horse car has weighing one-fourth as much and traveling at less than one-half the speed. Moreover, when horses were employed there were ten feet extra length in which to stop the car. This extra length is no longer available since the advent of electric cars. Unless cars have proper brakes high speeds are therefore most dangerous.

The great muscular strain with hand-brakes gradually tires out the brakeman, so that after a few hours' handling of a grip lever or controller handle, he finds his strength decreasing. Realizing this, for the rest of the day the brakeman slows up earlier than strictly necessary, or (as often happens) does not stop at all and lets cars run past crossings, missing passengers, who do not always wait for the next car, but walk instead. If, however, the brakeman has ready for instant use an ally in the shape of power requiring but the touch of a handle to become available, he is placed in the best possible position to make as many stops in as short a distance as is necessary. Not being fagged out, he is better able to do his company more justice and is more on the alert to prevent accidents.

Probably seventy-five per cent. of recorded accidents is chargeable to inefficient brakes. Statistics of this sort are hard to tabulate, and some records show even a higher percentage. While hand-brakes often stop cars quickly, they do so by consuming excessive energy. This means waste and increases the maintenance account. Then, too, it is impossible for a motorman to maintain his maximum strength for a long time. In active service he has to apply brakes between 250 and 400 times daily. He can only exert his maximum strength spasmodically and temporarily, even when aided by the weight of his body.

Hand-brakes, unlike power-brakes, have no emergency stops; and it is necessary to have a separate brakeman for each trailer, while with a power brake only one motorman and one conductor is necessary for a motor car and two trailers, which, in this case, means a saving of $21 per week, or sufficient to soon pay the cost of an air-brake equipment.

Air-brakes are provided with reserve power stored in reservoirs, and, by having large enough capacity, the air pressure required for braking becomes practically inexhaustible. The air pump of a thoroughly good air-brake is most economical in operation. I requires no power when the car is starting or when it climbs grades. As it takes ten times the power to start a car that it takes to keep it going, the advantage of this is obvious. A good air-brake is so compact that very little room is required for it under car body. It has no cumbersome or complicated machinery to get out of order. It works automatically. It needs much less attention than an electric motor gets. It is only necessary to keep the mechanism clean and in order, and to lubricate the pump regularly. No hinges or springs annoy inspectors or employees. A good air-brake pump, the moment it has compressed sufficient air, cuts out and runs in free air with the axle. A good air-brake entirely replaces a hand-brake. The hand-brake may be left on the car, and the air-brake can be so attached as to leave the hand-brake available should it be required. A good air-brake requires no expert to operate it. It is so simple that a child can work it. This being so, a railway manager is not restricted to hiring men of a certain height or weight, for when work is done by compressed air instead of muscular strength, no Samson is required to work the handle. A good air-brake enables a man to make the best possible stops without noise, jar or injury to apparatus. In hand-braking much excess force is used. This means that rods and bars are strained when stopping car, and often brake gear is in such shape that, when a quick stop is required, some part is sure to collapse.

The all important question is whether the first cost of a good air-brake is too high, or not, in proportion to the advantages gained. No accountant can figure accurately how many dollars of damage claims will be avoided; nor how much revenue will be increased by the quicker schedules made possible with air-brakes (for even seconds count); nor what the gain in labor account will be by not being restricted to hiring any particular height or weight of man; or how much the life of car body, truck and motor will be prolonged. There is a decided gain from whatever point the air-brake is viewed.

Curious Coincidence.

An English minister, in a sermon in which he spoke of the growing disinclination to believe in anything that could not actually be seen, made the following remark: "There are things around us which we cannot see, although we are sure they are there," at which moment all the electric lights in the church went out.

The Age of Niagara Falls.

According to some calculations made by Prof. J. W. Spencer, the human race has for 31,000 years been neglecting the dynamical possibilities of Niagara Falls, and will have only another meagre 5,000 years in which to make up for lost time.—The London "Electrician."

Destructive Arcing of 500-Volt Fuses.*

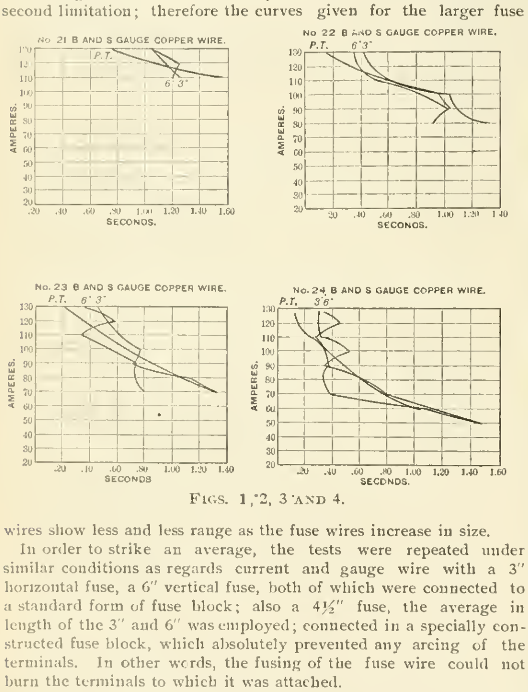
BY W. E. HARRINGTON.

A series of carefully conducted tests were made to find the relation between the fusing currents of different copper wires, ranging from No. 30 to No. 21, B. & S. gauge, the time required to open the circuit, and to what extent the arc contributed to the time required.

The tests were conducted across the bus bars of switchboard of the Camden Horse R. R. Co., Camden, N. J. Average voltage, 515 volts.

Before throwing a fuse in circuit, a water rheostat was set, using a Weston ammeter for this purpose, so that the current desired would flow through the fuse, when the circuit was completed by the traveler on the trackway. The different sized fuse wires were subject to the following limitations: the time of the traveler running full length on the trackway 1.5 seconds; current ranging from 20 to 130 amperes in 10 ampere steps.

The smaller fuse wires would fuse with the minimum current of 20 amperes, and in all instances inside of the 1.5 arc limits. Consequently, the curves show a wide range, but in the larger sized, wires, a greater current was required to fuse the wires in the 1.5 second limitation; therefore the curves given for the larger fuse



FIGS. 1, 2, 3 AND 4.

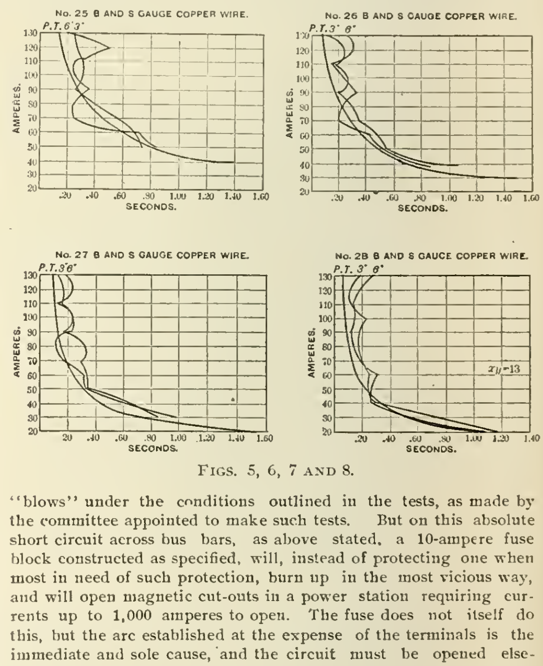
wires show less and less range as the fuse wires increase in size.

In order to strike an average, the tests were repeated under similar conditions as regards current and gauge wire with a 3″ horizontal fuse, a 6″ vertical fuse, both of which were connected to a standard form of fuse block; also a 4½″ fuse, the average in length of the 3″ and 6″ was employed; connected in a specially constructed fuse block, which absolutely prevented any arcing of the terminals. In other words, the fusing of the fuse wire could not burn the terminals to which it was attached.

The results recorded graphically in the following charts give, therefore, the time required in fractions of a second for the circuit to be opened under identically similar conditions as regards current and gauge of wire for a 3″, a 6″ unprotected and a 4½″ protected terminal fuse. The curves as given in chart No. 8 for No. 28 B. & S. copper wire, illustrates excellently the erratic character of the fusing of wire under conditions as observed in the practice of today.

The time required to open a protected terminal fuse wire becomes less and less as the current increases and grows less regularly, showing that a regular law is followed. The curve is an hyperbola having its asymptotes for its axes, and the equation for it is $xy=13$ for No. 28 copper. Whereas, the two unprotected terminal fuses are uncertain, and show in a very pronounced manner wherein the terminals contribute to this end; the conclusion one is forced to draw is that a fuse wire in practice, when it fuses, does not do as it was intended to, open the circuit, but establishes a condition, though the time may be limited, wherein the terminals act as a magazine to furnish the gas through which the circuit is continued. The curves throughout do not show any superiority of the 6″ fuse over the 3″. Looking at the results in comparison with those of the Board of Fire Underwriters, the very point they should have observed was overlooked, to wit, the continuance of the arc through but a short period of time, at the expense of the terminals, and the possibility of the vicious gas thus generated, coming in contact with other circuits and establishing other and more serious conditions, such as short circuits and possible fires. Not to be misunderstood, while the tests as are herein recorded show no superiority of the 6″ unprotected terminal fuse wire over the 3″ unprotected terminal fuse wire, the 6″ fuse wire is unquestionably safer when conditions are more extreme, such as, for instance, when a short circuit occurs.

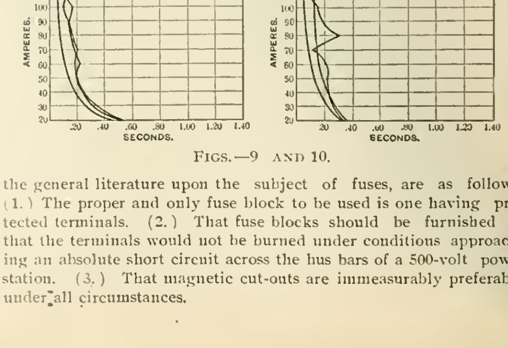
The determining factor in this matter of fuses is: What are the conditions required to protect against absolute short circuits across the bus bars of a large power station 500-volt switchboard? Tests are conducted showing how fuses act under conditions that are predetermined, certain currents which are made to flow, etc., but you never see anything published or advice given in this matter of fuses for the condition which really occurs the most frequently, that is, absolute short circuits. The Board of Fire Underwriters' Report gives the different length fuse blocks required for 10, 20, 30, 40 amperes, and so on. Now the requirements and limitations as prescribed in their report are true and perfectly safe when the fuse



FIGS. 5, 6, 7 AND 8.

"blows" under the conditions outlined in the tests, as made by the committee appointed to make such tests. But on this absolute short circuit across bus bars, as above stated, a 10-ampere fuse block constructed as specified, will, instead of protecting one when most in need of such protection, burn up in the most vicious way, and will open magnetic cut-outs in a power station requiring currents up to 1,000 amperes to open. The fuse does not itself do this, but the arc established at the expense of the terminals is the immediate and sole cause, and the circuit must be opened elsewhere.

The conclusions one is forced to draw from the above tests and



FIGS.—9 AND 10.

the general literature upon the subject of fuses, are as follows: (1.) The proper and only fuse block to be used is one having protected terminals. (2.) That fuse blocks should be furnished so that the terminals would not be burned under conditions approaching an absolute short circuit across the bus bars of a 500-volt power station. (3.) That magnetic cut-outs are immeasurably preferable under all circumstances.

*A paper, slightly condensed, presented at the Atlanta meeting of the American Street Railway Association.

What Shall Be the Measure of Phase Difference?

To the Editor of The Electrical World:

Sir:—In their letter to The Electrical World of October 20th, 1894, Siemens & Halske touch upon a matter of importance that has heretofore received very little attention. They say "it is to be observed that with curves differing from the sine form the diagram constructed for the combination of currents does not give accurate values, as this diagram is only correct for sine form curves. Hence, we cannot replace non-sine curves by so-called equivalent sine curves, that is, curves having the same mean square and which give equal values as one special sine form curve. For example, for an E. M. F. curve whose amplitude was 1.120 of the mean value of the

	Mean E. M. F.		Amplitude.
	Observed.	Estimated.	Observed.
Simple curve..............	100	......	1.130
Sum of two curves differing in phase 120°............	108.5	100	1.982
Difference between two curves differing in phase 120°......................	167.2	173.2	1.303

E. M. F., we have the results given in the table above:"

The phase difference of 120° is evidently the difference between the zero values of the alternating E. M. F.'s and not the actual difference of phase of the E. M. F.'s. taken as a whole. I construct a diagram for the sum of the two E. M. F.'s 100 + 100 = 108.5 used in making the measurements reported in the above table, and find the difference is 113°. I now assume that this is the correct angle and proceed to estimate the difference of the same two E. M. F.'s. I do this graphically by constructing a diagram for 100 — 100 at 113° difference of phase, and obtain as an estimated result 167.4 volts, while Siemens & Halske find by direct measurement 167.2 volts, an entirely practicable agreement. The phase difference for all forms of alternating current and E. M. F.'s should be stated for the entire values of current and E. M. F. instead of for the attainment of particular values and used as such. It seems to me that this is reasonable and convenient for all practicable purposes. A short time ago I had occasion to check the utility of this designation of phase differences for irregular curves with the following method and results: The measurements were made to determine the core loss of a 30-light 1,000-volt-50-volt transformer. A non-inductive resistance was placed in series with the transformer primary. The primary terminal where this resistance was placed was connected to one terminal of the secondary in such a way that the fall of potential produced by the primary leakage current, through the non-inductive resistance and the secondary E. M. F., would be added. The fall of potential, secondary pressure, and the sum of the two were observed with a multicellular electrometer. The value of the non-inductive resistance was 608 ohms; transformer primary turns 640; secondary turns 33; ratio of turns 19.4.

Observed Values.		Calculated.	
Fall of potential........	50.5 volts.	Primary pressure......	1,100 volts.
Secondary pressure....	56.7 "	Primary current.......	.083 amps.
Sum of these............	99.3 "	....	.....

The diagram for 50.5 + 56.7 = 99.3 gives a phase difference of 44.7°, for which the cosine is .71.

Apparent watts taken up in the primary, 1,100 × .083 = 91.3.

Actual estimated power taken up in primary, 91.3 × .71 = 54.8 watts.

A pressure of 56.7 volts was then applied to the secondary through a standard Weston wattmeter with the primary on open circuit at the same periodicity as that at which the above measurements were made, and the power taken up was observed to be 65.0 watts. This power determination is made where none of the E. M. F.'s and currents are sine forms, the primary current differed most widely from the sine form. Furthermore, analysis shows that this use of phase difference is convenient and entirely usable.

I agree otherwise heartily with the well placed arguments of Siemens & Halske in favor of the general utility of sine forms of E. M. F.'s.

HARRIS J. RYAN.

Ithaca, N. Y.

Reactance.

To the Editor of The Electrical World:

Sir:—In your issue of October 20, you express a hope that the definition of reactance may be thoroughly ventilated and discussed. As adopted by the American Institute of Electrical Engineers and used by Messrs. Steinmetz and Bedell, reactance means the ratio in an alternating current circuit of the quadrature component of the electromotive force to the current. As proposed by the Société Internationale des Electriciens, and used by MM. Hospitalier and Blondel, reactance means that quantity the square of which added to the square of the resistance of a circuit traversed by a periodic current gives the square of the apparent resistance. It appears to me that the former definition is preferable, for the former defines directly by means of a physical property, whereas the latter defines indirectly by means of an algebraic expression. The former has also the advantage of including the latter as a special case.

M. Blondel objects that the general idea is no longer that of a constant, and therefore is not properly denoted by an *ance* word; but in his own less general idea the thin edge of the variable has already entered in the form of the period and type of the wave.

So far from its being a defect of the more general definition that it unites under one word "un amalgame complexe et hétéroclite de toutes espéces de réactions," that appears to me to be its excellence, for they are united by an important physical bond. The definition is a physically real definition.

It is true, as M. Blondel points out, that the more general definition of reactance logically involves a more general definition of resistance, namely, the ratio of the co-phase component of the electromotive force to the current. The qualification "apparent," no longer required to express impedance, would appropriately distinguish the more general from the ohmic resistance; but it does not follow that it would be necessary to distinguish the more general from the less general reactance. The qualification "apparent" suggested by M. Blondel appears to me to be more correct than the qualification "equivalent" suggested in their letter by Messrs. Houston and Kennelly.

ALEXANDER MACFARLANE.

Ithaca, N. Y.

Fly Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir:—I cannot refrain from making a remark or two on the now popular subject of fly-wheels. The only danger that I can see in the case of short circuits is that of wrecking the spokes due to the cantilever strain placed upon them by the inertia of the rim. Of course after these are gone the rest follows. I cannot approve of building a fly-wheel in sections any more than is necessary for convenience in erection. The spokes have practically no stress other than traverse and the rim none other than that of tension. It seems to me therefore foolish to weaken the rim by joints any more than necessary. With perhaps the exception of belt driving fly-wheels where there is possibly slight compression on the spokes these stresses are exactly those which cast iron should not be called upon to bear, especially in modern high speed fly-wheels.

It is folly to attempt to strengthen the fly-wheel by thickening the rim for the stress increases in direct proportion to the cross section, so that the stress per square inch is stilll the same. A stronger material, not a different design, is the solution of the problem. Turning to the other material, wrought iron and mild steel, we at once see that a cast fly-wheel is out of the question. Sheet iron fly-wheels have been built with a solid web and pieces bolted onto the rim. But the ideal fly-wheel will not be made till a solid disc with flat endless iron or steel rings bolted or riveted on to either side of its periphery is produced.

Providence, R. I. GEORGE T. HANCHETT.

Patent Office Systems.

In referring to the decision regarding the Edison feeder and main patent, the London "Electrical Rev ew" says "what a commentary on the boasted perfection of the examination system of the American Patent Office! It seems that with all the expert examiners, interferences, references, and the other elaborate machinery necessary to carry on this patent office, that a patent can be obtained without an invention. . . . It clearly points to the futility of examination, and proves what we have always held, that it is vexatious, expensive and useless."

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Light from Electrical Oscillations.—A translation of the paper by Mr. Ebert, under the title of "Persistent Electric Oscillations and their Effects," abstracted in the Digest Oct. 6, is published and discussed editorially in the Lond. "Elec. Rev.," Oct. 12, a full reprint of which will be found in another column. In the editorial discussion it is stated that the article deserves careful consideration by electrical engineers; "we fear it must be admitted that the electric light as at present produced, has no prospect, as far as regards cost of production, of competing with gas or oil;" referring to the experiments of Langley and Very in 1890, with the light of the firefly, it is stated that they showed that this light was produced at one 400th the cost in energy at which it was produced in the candle flame and at an insignificant fraction of the cost at which it was produced in the electric light. The first requisite for further advance in this direction is the invention of a high frequency transformer which will be small enough to be connected with each lamp; Tesla has shown that these currents are not dangerous and the absence of heat would increase the advantages over the present system.

UNITS MEASUREMENTS AND INSTRUMENTS.

Photometric Units and Quantities.—In the Digest August 11, an article of Prof. Blondel was abstracted suggesting a system of photometrie units and in which the compiler drew attention to the objection to the French term "illumination" for the quantity which is equal to the product of what is in English, illumination by the factor time. "L'Ind. Elec.," Oct. 10, contains a letter from Prof. Blondel referring to this criticism, in which he suggests that the English speaking people change their word "illumination" to "enlightment," which he says corresponds exactly to the word "eclairement"; the term illumination has been adopted by an International Congress (of photographers) and it is therefore difficult to abandon it completely; but as the term is not free from objections it might be replaced by "lumination," which is a perfectly correct term and one which he thinks will be acceptable; the quantity represented by it is rarely used outside of photography and physiology and ought therefore not to cause confusion; but all confusion could be avoided if the English name is made "time-lumination," as suggested by the London "Electrician's" translation "time-illumination" (see Digest, Aug. 25). Regarding the other English terms he thinks those suggested in the Digest are correct translations and ought to be adopted without difficulty by English speaking electricians. In a table he gives the French, the English and German words and the international names of the units; the English are the same as those in the Digest, Aug. 11, except that for "intrinsic brightness" he prefers the term "intrinsic brilliancy;" (for the term "quantity of light," Mr. Hospitalier suggested "lighting," as stated in the Digest, Aug. 25); the German terms are the same as those given in the Digest, Sept. 22, with the word "strahlung" added for "intrinsic radiation. Regarding symbols, he thinks it best to wait until the definitions and units have found general acceptance. In the accompanying article by Mr. Hospitalier, he accepts the word "lumination" as satisfactory; in the next issue he promises a proposition for a system of symbols.

Photometry of Diffused Reflection.—A translation of a theoretical article by Mr. Lommel abstracted from the "Wied. Ann.," vol. 36, 1889, p. 473, is published in the Lond. "Elec.," Oct. 12. He states several propositions, one of which replaces Lambert's cosine law. Among others he states the two following propositions: "If an absolutely white body is illuminated by parallel rays from any direction, the amount of light sent out in all directions from its surface (its illuminating power) is proportional to the cosine of the angle of incidence. If the surface of an absolutely white body is equally illuminated from all directions, the quantity of light radiated by it in any given direction is proportional to the cosine of the angle of emergence." Observed results for paper and cardboard approach the new law more closely than the cosine law, but there is not even an approximate correspondence; for porcelain the divergences from the co-sine law amount to 31 per cent., but do not exceed 4 per cent. in the case of the new law.

Wire for Rheostats.—In the "Elek. Zeit.," Oct. 11, Mr. Strecker comments on a statement made by Messrs. Hertzog & Feldmann, in which they say that high resistance materials for rheostats for strong currents are not as suitable as copper or iron, proving the same theoretically, in which proof they show that the volume increases with the specific resistance of the material. He states that this formula, although it may be theoretically correct, is of no practical value; it is well-known that thick wires are not suitable for rheostats and that only small wires or ands are used, in which it may be said that the allowable current is directly proportional to the cross-section, which statement is not exactly correct, but it may be used for the comparison of different materials if it be understood that wires no larger than No. 20 to 14 B. & S. gauge are to be used; he discusses it theoretically and shows that the volume is nearly independent of the specific resistance and that the volume for high resistance materials will be somewhat smaller than that of good conductors; the chief advantage of high resistance materials is that a less length of wire is required, the less the higher the specific resistance; the construction of a rheostat will show that the chief cost is not the wire, but the supports, the cost of which will be greater for longer wires.

Duncan Meter.—The "Elek. Zeit.," Oct. 11, contains an editorial in which it is stated that this meter is not yet a solution of the problem of a really reliable meter, for two reasons; the speed of rotation is, as in all meters on this principle, dependent on the frequency, and the instrument must therefore be calibrated for every frequency; furthermore the instrument integrates the quantity of current, but not the power, and therefore if arc lamps or motors are in the circuit, which cause a shifting of the phase, the meter will register more than what corresponds to the real power consumed.

Theory of Wimshurst Machines.—The French Academy paper by Mr. Schaffers, mentioned in the Digest last week, is contained in full in "L'Ind. Elec.," Oct. 10.

Board of Trade Laboratory.—The conclusion of the article in the Lond. "Elec.," Oct. 12, contains a detailed description of the 100-volt multicellular voltmeter; also a description of the use of the instrument; a general plan of the laboratory is also given. In the continuation of the description in the Lond. "Elec. Rev.," Oct. 12, the engine and battery rooms, cable tank, testing-room and the machine-room are described, illustrations of the two latter being given.

Central Laboratory of Paris.—"L'Elec.," Oct. 6, publishes the rules governing this laboratory and the charges for tests and calibrations of various kinds.

DYNAMOS AND MOTORS.

Unipolar Machine.—An article by Mr. Ziegenberg is begun in the "Elek. Anz.," Oct. 7; in the issue of Oct. 11, he describes and illustrates a suggestion for a machine which has some interesting features; the field, with its coil, is made to rotate while the armature is at rest, by which device he avoids the sliding brushes on the outside edge of the armature which is at rest; the armature is in the form of a wheel with spokes which extend from the outside of the machine through the air-space toward the inside where the coil lies; the current is led off from the outside edge by fixed connections, while from the inside edge it is led off by brushes and wires leading to sliding contact rings on the outside of the machine; (how this disk is supported is not shown, but the intention is doubtless to support it from the outside); the illustration is merely diagrammatical.

Alternators in Parallel.—The subject is discussed in "L'Elec.," Sept. 29, in which a description of the Kapp system (see Digest, Sept. 29) is included.

TRANSFORMERS.

Transformers' Losses.—"L'Ind. Elec.," Oct. 10, abstracts briefly from a book by Mr. Feldman, the results of some observations made in a number of central stations. A 10-kw transformer is fully loaded for a mean of 440 hours per year, and if the losses are 2 per cent. in the iron and 2 per cent. in the copper, it requires 6,240-kw hours and the mean electrical efficiency for the year will be 70.5 per cent., with a maximum of 80.2 per cent in December, and a minimum of 55.4 per cent in May; if the losses are 3 per cent. in the iron and 2 per cent. in the copper the annual efficiency will be 61.8 per cent., with a maximum of 73.4 per cent., and a minimum of 45.5 per cent.; if the losses are 1.5 per cent. in the iron and 8 per cent. in the copper the annual efficiency will be 72.5 per cent., with a maximum of 79.9 per cent., and a minimum of 60 per cent.; from this it appears that the last proportions for the internal losses are the best.

Graphical Predetermination of Transformers and Multiphase Motors.—The "Elek. Zeit.," Oct. 11, contains at some length a mathematical article by Mr. Heyland, in which he describes the process in which the induction diagram is so constructed that on the basis of a constant potential the various results can be measured.

ARC AND INCANDESCENT LIGHTS.

Diminishing the Consumption of Arc Light Carbons.—The "Elek. Anz.," Oct. 7, describes a device by Mr. Jehl which consists essentially

of a bell shaped hood, opened downwards and covering the lower end of the upper carbon which slides through the top of the hood, the lower end of the carbon being on a level with the lower edge of the hood; this hood is carried on an insulated frame resting on the lower carbon by means of platinum wires which extend part way to the point of the carbon, thus allowing the whole apparatus to move down as the lower carbon is consumed; the action of this hood is to collect the gases which are produced and keep the point of the upper carbon surrounded by them, which reduces the consumption of this carbon quite materially. Tests made with a 6-ampere lamp without the apparatus showed a consumption of 14 mm. and 15.5 mm. of the upper and lower carbon respectively, while with the apparatus the consumption was 4.9 and 10 mm. respectively; a 9-ampere lamp which, without the apparatus, would burn 9.5 hours, burnt 25 hours with the apparatus. (Although not so stated, it appears that this apparatus is applied to existing lamps and replaces none of the mechanism of the lamp itself.

Cost of Electric Light.—A few comparative figures for electric light and gas are published in the Lond. "Elec. Eng.," Oct. 12.

ELECTRIC RAILWAYS.

Suspended Railway.—An editorial in the "Elek. Zeit.," Oct. 11, discusses the Langen system (see Digest, Oct. 13) in which the cars are suspended from an overhead track; the advantages claimed are: greater security; the possible use of a single rail or when two rails are used to bring them much closer together, thus increasing the facility of passing sharper curves; the height to which the passengers have to ascend is less than on overhead lines; that the cars will swing like a pendulum and relieve the supports of horizontal strain; that the construction is cheaper and simpler, and that it does not cause a noise. The editorial calls attention to the fact that a similar system was suggested eight years ago and that another one was started in Ireland, but that since then the system has made no progress, from which it may be concluded that the theoretical advantages have not shown themselves to be such in practice; it is believed that the technical difficulties would be quite great; it is shown that there would be a horizontal stress and that it will involve difficulties to make the curves quite sharp, partly on account of the centrifugal force and partly because the wheels must be far enough apart to admit of placing the motor between them; it is believed that the danger of derailment in case of a single rail is greater than with two rails. A description of this system with comments, is also given in the "Elek. Echo," Oct. 13.

Canal Boat Propulsion.—"L'Ind. Elec.," Oct. 10, contains an illustrated description of an apparatus which has recently been tried; it consists of a propeller attached to the far end of the rudder and driven by an electric motor placed on the top of the vertical shaft of the rudder and driving the propeller by means of beveled gears running in a reservoir of oil; one of the advantages of this system is that it requires no change in the boat except the change of the rudder; the vertical pressure due to the weight of the armature is balanced by a magnetic system, which has the advantages of having no loss due to hystereses (but which is not described); the weight of the whole rudder is balanced by making it hollow, so as to cause an upper pressure by displacement. It was tried on a boat 125 ft. long, of 180 tons, which attained a speed of 2.8 ft. per second, which is said to be 40 per cent. higher than that attained by two horses; the power consumed was 3.4 kilowatts; in certain favorable cases the speed was 3.3 ft. per second; the current was furnished by a battery of accumulators; the experiments were very successful, the chief advantage being the increased speed; even with accumulators the cost was less than that of animal traction; where traffic warrants it an overhead wire and trolley connection would be used; this will soon be carried out at Perrilly; it is thought that the water-power in the locks is generally much greater than that necessary for the traction.

Vienna Railway.—The concession for the underground railway across Vienna has been granted. Some statements regarding it are contained in the "Elek. Zeit," Oct. 11.

Electric Railways in the United States and Canada.—A reprint of Mr. Wilkinson's paper is begun in the Lond. "Elec.," Oct. 12.

Influence of Street Railway Circuits on Telephone Circuits.—See abstract under "Telegraphy, Telephony and Signals."

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Stage Light Regulator.—Mr. Mueller, in the "Elek. Zeit.," Oct. 11, describes the principle of a regulator for alternating currents. He states that regulation with choking coils cannot be used; his method consists in leading a number of branch wires from different parts of the secondary coil to step by step regulators; the short-circuiting of the windings between two branch connections is avoided by placing in each branch circuit a small choking coil; the number of the latter may be made half as great by connecting every other branch connection with the contact point on the rheostat and the intermediate ones with the next one above through small induction coils. The advantage of such a regulator over a wire resistance rheostat is to economise energy when the lamps are dimmed.

Berlin.—A brief but interesting summary regarding the foundation and growth of the single system, comprising five central stations in this city with a total capacity of 150,000 lamps of 16-cp, is published in the Lond., "Elec. Rev.," Oct. 12; as an average for the year 560 watts of current were obtained per kilogram (2.2 lbs.) of coal, a result which it is claimed has never before been reached in any central station in the world.

Worcester.—A well illustrated description of this combined water and steam power station, using high tension alternating currents, is published in the Lond. "Elec. Rev.," Oct. 12. The greater part of the issue of Oct. 12 of the Lond. "Elec. Eng." is devoted to a long and profusely illustrated description of this station.

Calais.—A brief illustrated description is given in "L'Ind. Elec.," Oct. 10; alternators are run with gas engines, but it is thought that the example will not be followed very often; a table of the results of some of the tests is given.

Governing Electric Light Engines.—The Lond. "Elec.," Oct. 12, reprints and discusses editorially an article from the London "Engineer."

WIRE, WIRING AND CONDUITS.

Oil Insulation for Feeders.—According to the Lond. "Elec.," Oct. 12, the high tension feeders for the installation at Worcester are to be laid according to the Brooks system (in which the wires are run through pipes containing oil); the system has proved itself to be very satisfactory at Chatham, Rochester and Keswick, and numerous other places where it has been in use for some years.

Long Trolley Wire.—According to the "Elek. Anz.," Oct. 11, a German firm makes trolley wire in single lengths of a weight of 3,300 lbs.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Influence of Street Railway Circuits on Telephone Circuits.—The "Elek. Zeit.," Oct. 11, contains an interesting article by Dr. Wieslisbach, in which he discusses the subject and shows how the difficulties have been overcome in the city of Zurich. He states that experiments made on special circuits of 300 ft. are of no use; regarding the earth return currents he shows the great influence which the rail joints will have on the production of earth currents, if they are not very well made and even then the joints in time become bad; a single bad joint may give rise to injurious earth currents; this difficulty has been completely overcome in Switzerland, at least as far as telephone circuits are concerned, by laying an earth return wire of copper as large as the trolley wire, in the earth between the tracks and connecting it with the rails at points at most 300 ft. apart; the suggestion of Mr. Pearson to connect the positive instead of the negative pole with the trolley wire, would hardly be accepted by engineers as it involves a more rapid destruction of the trolley wire, and it would be much better to replace the trolley wheel more frequently than to renew the trolley wire. The effect of induction is not as easily guarded against; a parallel distance of 1,500 ft. with wires 30 ft. apart has been shown in Zurich to cause a noise in telephones which interferes with communication; it was found that even in metallic loop circuits the noise was only slightly less than on single circuits, but it was thought that in this case it was caused by a secondary induction from the single telephone lines and by making these metallic circuits no noises were heard; this was not the case, however, on the interurban lines of 100 miles and more, in which the noise was weaker in dry weather and louder in wet weather: a noise in these lines also induced a noise in the other lines on the same poles, and even if the good line was connected to a totally different line on which under ordinary circumstances there was no trouble; to avoid this the interurban lines were changed to another street, which overcame the difficulty completely. His conclusions are that a single line running parallel to a trolley circuit for more than 300 ft. cannot be used; metallic circuits can be used up to three miles under the conditions that all neighboring telephone circuits are metallic; long circuits are best transferred to another street; crossings cause no trouble if they are not too frequent, that is not more than three. Regarding the trouble caused by direct contact of the wires he shows that lightning arresters are not sufficient; to guard against a sudden current he recommends strips of tinfoil; to guard against a continuous current which would generate injurious heat in coils, the fuse would have to be so small that the slightest atmospheric discharge would rupture the circuit; to overcome this a double protection is used; the fisrt consists of a tinfoil fuse which will melt at 4 to 5 amperes and the other is made of a fine German silver wire wound around a copper core which is soldered with an easily fusible alloy to some support; if a continuous current sufficient to heat this coil passes through the line, this alloy will melt and the copper core, which is held by a spring, then connects the circuit to earth which cuts out the apparatus, thereby decreasing the resistance and the consequent increase in current will then melt the fuse; the fuse is connected to the line side of the lightning plate and the German silver wire on the side toward the apparatus; with a single layer of German silver wire 0.1 mm. in diameter the apparatus will act with a continuous current of 0.1 ampere.

Underground Telephone Wires.—Dr. Weislisbach, in the "Elek. Zeit.," Oct. 11, states that when there are more than 100 wires it will be cheaper to lay them underground in a cable with paper insulation, than to run them overhead; the first cost is not appreciable higher, while the cost of maintenance is very much less, besides which speech is, as a rule, transmitted better.

Telephone in the Courts.—According to the "Elek. Zeit." Oct. 11,

three microphones have been placed in the Supreme Court of England with which lawyers and others may make connections to their offices, thus enabling them to listen to the proceedings without losing time in waiting for particular cases.

Progress in Telegraphy.—An abstract of the Board of Trade statistics is published in the Lond. Elec. Rev.," Oct. 12. Among other things it is stated that the first telegraph line was in Germany in 1833, the next in England in 1837 and the next in the United States in 1844, the last country adopting it being Spain, in which the first line was laid in 1885. The proportion between the number of messages per year and the population as a whole is now 1.8 message per head in the United Kingdom, 1.2 in Switzerland and 0.9 in the United States.

Speed of Submarine Telegraphy.—In a discussion of the subject in an editorial in the "Elek. Zeit.," Oct. 11, some figures are given on the line from Newcastle to Finland, in which the advantages of automatic transmission are shown. (Submarine.) A few figures concerning the Anglo-American Company's lines are given in "L'Elec.," Oct. 6, and "Elek. Zeit.," Oct . 11.

The 1894 Atlantic Cable.—The Lond. "Elec.," Oct. 12, contains an interesting descriptive article by Mr. Dearlove, giving tables of data and cross-sections of the various parts of the cable.

Pacific Cable.—The Lond. "Elec. Rev.," Oct. 12, contains an editorial on this subject; it concludes from the Ottawa conference that a good deal of preliminary work has yet to be done before the accomplishment of this great scheme is well within touch; it expresses disappointment at the results of this conference.

Telegraphy and Telephony in Cochin-China and Cambodia in 1893.—"L'Elec.," Oct. 6, gives a brief description.

ELECTRO-CHEMISTRY.

Chemical Theory of Accumulators.—The article by Mr. Wade is continued in the Lond. "Elec.," Oct. 12. He examines the only other remaining theory, the generally accepted one, of the direct formation of lead sulphate at both electrodes by the abstraction of two molecules of sulphuric acid, which are replaced by two molecules of water; the second molecule of sulphuric acid does not undergno electrical decomposition but is involved in a secondary reaction; the thermo-chemical equation for this case gives 1.855 volts, which although better than the others still leaves too large a discrepancy; it assumes, however, that the acid is diluted with a very large quantity of water. A curve is given, showing the results of Messrs. Gladstone & Hibbert and giving the observed voltage in all strengths of acid from 100 per cent. to zero; the two end portions of it are of little interest as they involve secondary and local reactions; to find how far this curve agrees with the calculated E. M. F. for various strengths of acid, he interpolates values between the two extreme cases of pure acid and very dilute acid by substituting successively the heat formation of the various proportions in the thermo chemical equation and obtains a curve which does not agree very well, giving in general, considerably lower values. He then shows that a reaction exists due to changes in the electrolyte which has heretofore been overlooked; "full allowance has been made for the energy required to separate two molecules of acid from the water with which it is diluted, but no account has been taken of the energy due to the further dilution of the remaining acid by this liberated water together with the two molecules of water which replace the acid which has been used up;" making this correction in the thermo chemical equation he obtains the value 2.0 volts; a corrected curve is given which practically coincides with that obtained by actual measurement between cells containing from 10 to 65 per cent. of acid corresponding to specific gravities from 1.070 to 1.570, which is a far wider range than is ever used in practice; he concludes that it may now be fairly claimed that the double sulphating theory of discharge does account for the E. M. F. strictly in accordance with Thomson's law, and from a thermo-chemical point of view therefore the case may be considered as proved. He draws some conclusions from this, showing the importance of considering the amount of acid and its distribution; he points out that a large excess of acid in a proportion from three to five times the necessary amount has been finally adopted; free access to the electrodes is very essential and within certain limits cells work more efficiently the farther the plates are apart, in spite of the loss due to internal resistance; rapid diffusion and free supply are also necessary; he considers a hypothetical case from which he draws interesting conclusions, among which are that an insufficient supply of acid means a rapid fall of voltage and therefore a smaller output, but the efficiency is not affected; imperfect diffusion, however, means a loss of efficiency.

Accumulators.—In an article in "L'Elec.," Oct. 6, Mr. Leroy refers to the recent paper of Mr. Darrius (see Digest, Sept. 15, 22) in which it was shown that the efficiency was less than when the accumulators were connected in parallel, owing to local connections between the various cells; Mr. Leroy suggests that what is true of different cells in parallel may be true also of the plates in the same cell, resulting in a partial discharge between the plates themselves; he suggests that the experiment might be tried to discharge the separate plates first together in one cell and then in pairs in different cells; he concludes that for this reason the smallest number of plates possible should be used and that the connections between them should be made as well as possible, soldered instead of clamped, and that it is bad practice to introduce a new plate in the place of an injured one. He believes that it would be better instead of connecting all the plates of one cell together, to use the less common system of connecting each plate with a corresponding opposite plate in the next cell, using what is known as twin plates; this could readily be determined by experiment if such a series of cells was discharged and then again discharged with the plates all connected together.

Plating Aluminium.—A method devised by Mr. Goettig, and which has been commented upon very favorably by the Neuhausen Aluminium Company, is described briefly in the "Elek. Anz.," Oct. 11. If the aluminium is to be copper-plated it is rubbed with tin-foil, moistened with a nearly concentrated solution of copper sulphate; the principle of the method is that if certain metals whose solutions are not decomposed by aluminium, are rubbed on to the aluminium, an adherent coating of the metal will be produced if the material with which it is rubbed makes a galvanic cell with the aluminium and the solution such that the aluminium forms the cathode.

Electrolytic Preparation of Manganese.—The Voltmer method is briefly described in the "Elek. Anz.," Oct. 11.

Hermite Process—The Lond. "Elec.," Oct. 12, states that it has been decided to adopt this process at Ipswich; the decision was based on the exceedingly favorable report of the trials which have been made on the main sewers of the town during the past three months.

MISCELLANEOUS.

Coal Cutting.—In Mr. Snell's serial in the Lond. "Elec.," Oct. 12 some electrical coal cutting machines are described and illustrated.

Furnace—A description of the Moissan furnace, and his method of making diamonds and other products, is given in the "Elek. Anz.," Oct. 11; diamonds as large as 0.5 mm. in diameter have now been produced.

Destruction of a Cable by Lightning.—According to the "Elek. Anz.," Oct. 7, the cable in the Gothard tunnel was recently destroyed by lightning; this curious case is supposed to have been due to the fact that the lightning entered an overhead line at one end and found an easier path to earth at a lightning arrester at the other end.

Electric Ignition in Gas Engines.—"L'Ind. Elec.," Oct. 10, contains an article by Mr. Armagnat, in which he discusses at some length the various methods for electrically igniting the gas in gas engines and points out the defects and their remedies. Among other things he shows that the connections usually adopted by having a common wire for connecting the frame of the engine with both the primary and secondary of an induction coil, is not the best, and that often much better results would be obtained if there was no connection between the two coils; also that with a reversal of the connections of the two poles of one of the coils, when a common return wire is used, the spark may become greater or less, and that therefore a simple reversion of the connections may sometimes improve the spark considerably.

Water Level Indicator.—A device for indicating the water level at a distant point, is described and illustrated in the "Elek. Echo.," Oct. 13.

Electro-Therapeutics.—The Lond. "Elec. Eng.," Oct. 12, abstracts briefly an article from the "Lancet," describing some satisfactory applications of static electricity in the healing of certain skin diseases and ulcers, by Prof. Donmer of Lille.

Treatment in Case of Accident.—London "Lightning," Oct. 11, publishes a table of instructions adopted by the telegraph department of the Midland Railway, containing also instructions regarding the treatment in case of serious accident.

New Book.

ELECTRO-MAGNETIC THEORY. Vol. I. By Oliver Heaviside. London: "The Electrician" Printing and Publishing Company, Limited. xxii + 466 pages. Price, $5.00.

Mr. Heaviside is a man of genius, and his writings are always of great value and very interesting, even when we cannot agree with his conclusions. So independent and original is Mr. Heaviside's mode of thought that he grows impatient of what he considers the restraints of accepted methods, and becomes iconoclastic. Even the English language is not large enough for his expansive ideas without extensive additions, and accordingly he proceeds to coin a quantity of grotesque words, which frighten the timid reader, and send cold shivers down the back of the philologian. In this connection we would like to know why, after forcing the word "inductance" down the throats of the electrical profession as the only proper companion for resistance, the author should use the discredited "self induction" throughout the book.

Another reform advocated by Mr. Heaviside is the practical abolition of Euclid. On page 148 he says "Euclid for children is barbarous," and advocates the substitution of vector geometry. Right here we wonder whether vectors will do all that is done by Euclid, and turning back to page 143, where the author is explaining his vector algebra, we find that he appeals to that musty old barbarian, "Euclid I., 47," as authority for $r^2 = x^2 + y^2 + z^2$. It was not then altogether in vain that Pythagoras barbecued an ox in honor of the discovery of this theorem, if after two thousand years an Oliver Heaviside quotes it from Euclid instead of proving it by vectors.

Personally we do not agree with Mr. Heaviside about Euclid; we still cling to the old fogy notion that the study is a valuable discipline to the youthful mind, even when the theorems are never put to any use. Even the great Newton, who at first held Euclid in contempt, later revised his opinion and studied him carefully. We think the fact that Euclid has lasted two milleniums is not altogther due to vicious conservatism, but in part at least to the intrinsic merit of the book. Even if Mr. Heaviside has produced as good a vector geometry as he thinks he has, it by no means follows that Euclid either will or ought to pass into oblivion. After centuries of the printing press, and decades of the typewriting machine, we still have some use for handwriting; after half a century of the mowing machine we still use the scythe, and after two or three generations of the steamboat there are some sailing craft still left, to say nothing of rowboats.

It is this sanguine spirit of reform that leads Mr. Heaviside to look lightly upon all obstacles. The reform nearest his heart is the suppression of 4π where it does not belong and its introduction where it does belong according to his ideas. We admit at once that there is a great deal to be said on his side of the argument, and it may not be as difficult to make the change as most of us have supposed. By a strange coincidence Mr. J. T. Sprague is on the same side of the question as Mr. Heaviside.

In Mr. Heaviside's system the electrostatic unit of quantity of electricity is not, as with the present system, that quantity which repels an equal quantity at unit distance with unit force, but the force $= \frac{1}{4\pi}$ and the same applies to unit magnetic pole. In the present system the electrostatic capacity of a sphere of unit radius, is unity, and when charged with unit E. M. F. the surface density is $\frac{1}{4\pi}$ and the total flux of force is 4π. In Mr. Heaviside's system the capacity is 4π and the charge at unit E. M. F. is of course 4π the surface density unity and the total flux of force being as in the present system, 4π.

Admitting for the sake of argument that the advantages of Mr. Heaviside's system are as great, and the difficulties of making the change as small, as he says they are, we still have no guarantee that his system will be final. In the first place, there are sensible persons who do not approve of the metric system except in the one particular of the decimal relation of units so far as it is carried out. But granting the metre to be the ideal unit of length, and not to require any future alteration, there is a second fact worth considering.

There is a prevalent belief that the relation of physical quantities is such that it is necessary and sufficient to arbitrarily fix the magnitudes of three units (which are assumed fundamental), in order to derive the magnitude of the other units. This belief is probably partly due to the fact that Maxwell uses three arbitrary units—length, time and mass. This, however, was in deference to the British Association, which had already adopted the C. G. S. system. Those who will read Maxwell's chapter on units carefully will see that he there shows that only two arbitrary units are necessary, in order to derive all the others.

If we take as a unit of mass that quantity of matter which will attract an equal quantity of matter at unit distance with unit force, we make the unit of mass a derived unit. But we have apparently here assumed unit force an arbitrary unit; this, however, is only apparent. For if we consider the acceleration produced by the given mass on a second mass, we see that it is independent of the magnitude of the second mass. That is, if the second mass be increased to n times the attraction will be increased n times, and so the acceleration which the attraction will produce in unit time (if the attraction be kept constant while the second mass moves), is constant. We may therefore assume the second mass equal to the first and then the attraction by the definition of unit force now used in the C. G. S. system will be unity. In this system the dimensions of mass, are $T = [L^3 M^{-2}]$. It would doubtless be a more scientific system than the present system, but would not suit Mr. Heaviside unless we make the attraction between units masses $\frac{1}{4\pi}$

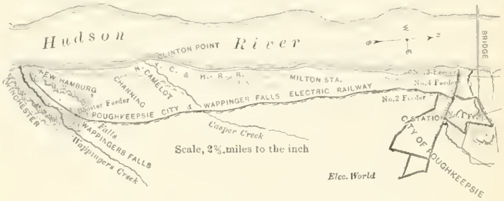
We have made this apparent digression to lead up to a very pertinent question. Is the whole scheme of units to be changed every time that anyone discovers that it would be possible to construct a more scientific one? If so, the one thing we can depend upon is that it will be a long time before we reach the final system, if indeed we ever reach it. Perhaps electricians will become so used to "positively last and final revisions" that they will not care how much or often the units are changed.

Space does not allow us to even mention all the original departures in this work, and we must leave them for the reader to find himself. While we do not by any means concur in all the author's opinions, we think that he h s made many valuable contributions to science.

A Model Electric Railway.

The electric railway between Poughkeepsie and Wappinger's Falls, New York, lately completed, is an example of good engineering work and comprises, among other features, an application of the "booster" system of feeding. The entire engineering supervision of the work has been under the charge of Mr. J. H. Vail, chief engineer of the Electrical and Mechanical Engineering and Trading Company, 39 Cortlandt street, New York, from whose offices all plans and specifications were issued.

The boiler-room contains two 300-hp Sterling boilers, and is of capacity sufficient for a duplicate battery. It is floored with brick, laid in cement and grouted. In the engine-room are two 200-kw General Electric multipolar generators, each of which is direct connected to a 300-hp Ball & Wood compound condensing engine. The foundations for these units are of extremely heavy masonry. As in the boiler-room, there is here space for duplicating the plant. The condenser, feed water heater and boiler feed pumps are located in the rear of the engines and close to the division wall. All of the piping is carried in pipe channels below the floor line, the floor being composed of twelve inches of concrete surfaced with an inch of Portland cement. The pipe channels are provided with cast iron covers, set flush with the flooring, this arrangement affording easy and convenient access to any part of the piping system. The switchboard is built up of black enamelled slate

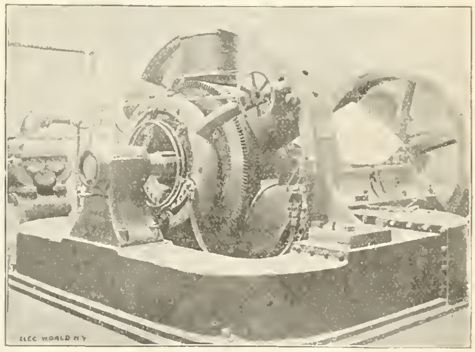


MAP OF LINE, SHOWING "BOOSTER" FEEDER.

slabs and is of the General Electric panel type. The dynamo leads run beneath the floor in vitrified pipe conduits. The track system consists of 10 miles of singleand double track, laid through the streets of the city. A spur 10 miles in length reaches from Poughkeepsie along the Ridge Road to Wappinger's Falls and thence to New Hamburg. The heaviest grades within the city limits occur on that portion of the line leading from the steamboat landing on the Hudson River, near the New York Central Depot, up Main street, for about one mile. The grades here vary from 5 to 8½ per cent. The track on Main street is laid with 90-lb. girder rails, furnished by the Johnson Company. The remainder of the track is laid with 60-lb. and 56-lb. T rails. The track is bonded throughout with two No. 0, B. & S. copper wires, riveted in place, all of the electric bonding being performed by the employees of the railway company, under the direction of the Superintendent.

The line leading from Poughkeepsie to Wappinger's Falls is nearly straight in its course, the grades varying from 1 to 8 per cent. Between Wappinger's Falls and New Hamburg, where the track leads down toward the Hudson river, the grade is as heavy as 9 per cent.

The line construction consists of the usual form of stout octagonal hard pine poles with treated butts. These are set up on Main street and



ONE OF THE GENERATING UNITS.

Market street, the remainder of the poles throughout being round, shaved and painted.

Spanwire construction is used throughout the city; bracket construction is used on the line leading to Wappinger's Falls and New Hamburg. The trolley wire is No. 0, B. & S., supported by 5-16 inch stranded steel span wire. The line material is of the H. W. Johns' manufacture.

Feeders of No. 4=0, B. &. S. wire are placed as required for electric distribution within the city limits. An interesting feature of the feeding system is the application of the booster idea to the long distance feeder from the power-house to Wappinger's Falls. The feeding poin is eight miles from the station with a 9 per cent. grade, two miles beyond the end of the feeder. By the use of the booster it is possible to properly supply this section of the line through two No. 4=0, B. & S. wires. The Woodbridge & Turner Engineering Co. constructed the line work,

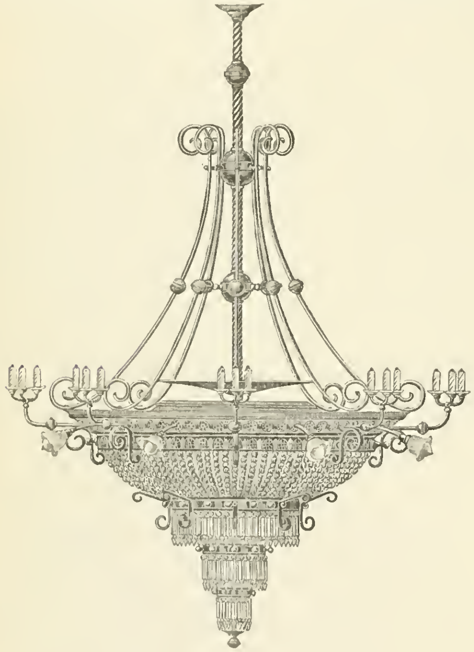
while the track construction, including bonding, was under the charge of Supt. C. M. Davis of the Railway Company.

The rolling stock equipment consists of eight closed motor cars, 18 feet in length, built by James A. Trimble of New York; ten open motor cars, 30 feet in length, built by the American Car Co., of St. Louis, Mo.; and two closed vestibuled cars, made by the latter company. All motor cars are mounted on the latest type of Peckham cantilever truck. The electric equipment of the cars consists of two G. E.-800 motors per car, with type K series-multiple controller. All cars are fitted with the Star electric headlights, and all closed cars with the American Car Heating Company's electric heaters.

The new electric railway will supplant an extensive passenger and express stage business between Poughkeepsie and Wappinger's Falls. It furnishes convenient transportation facilities between the river front and the higher urban localities, such as Vassar College, the Seminary, the Driving Park, the Insane Asylum, the P. & E. R. R. Depot, and the Cemetery. The same accommodations are offered at the New Hamburg end of the line, which reaches down to the river front.

Combination Fixture for Public Halls.

Since the recent fire, Saenger Hall, Newark, N. J., owned by Judge Krueger, has been enlarged and handsomely re-decorated and re-furnished, and the most prominent feature of the decorations are three prismatic combination fixtures, made by I. P. Frink, 551 Pearl street,



PRISMATIC COMBINATION FIXTURE.

New York. Each contains fifty gas burners, and fifty electric lamps, which light the hall so brilliantly as to have excited unusually favorable comment. Through the courtesy of the manufacturers we print herewith an illustration of one of the fixtures, which is known as the suspended, double-cone, prismatic sunlight type.

A New Motor.

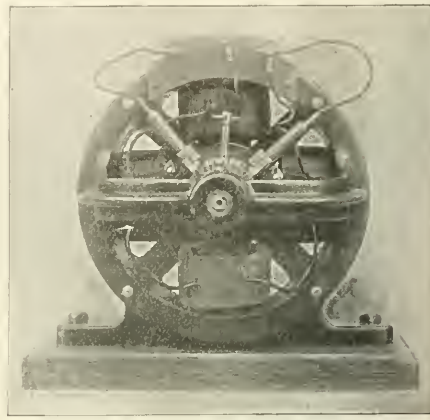
A new motor manufactured by the Elliott-Lincoln Co., Cleveland, O., is of the four-poled type, and is supplied with four field coils, making all four poles direct. The field coils are wound on forms and slipped over the poles. The iron in the field is so arranged, that there is the same cross section for the magnetic lines at all points of the magnetic circuit. The frame with the poles pieces and support for the pulley end are all cast in one piece, while the support for the commutator end is cast to a ring, which is bolted to the frame. This construction makes the bearings very rigid and stiff.

The brush holders are attached to the casting, which supports the commutator end of the armature, and have an indefinite range of adjustment. Arc light carbon pencils are used for brushes. These brushes give excellent service, and have the incidental advantage of being easily replaced. The bearings are supplied with a wick oiling device in the smaller sizes, and with a ring and self-centering bearing in the larger sizes. The speed is very low, that of the one-half-hp machine being 1,300 revolutions per minute.

A New Water Tube Boiler.

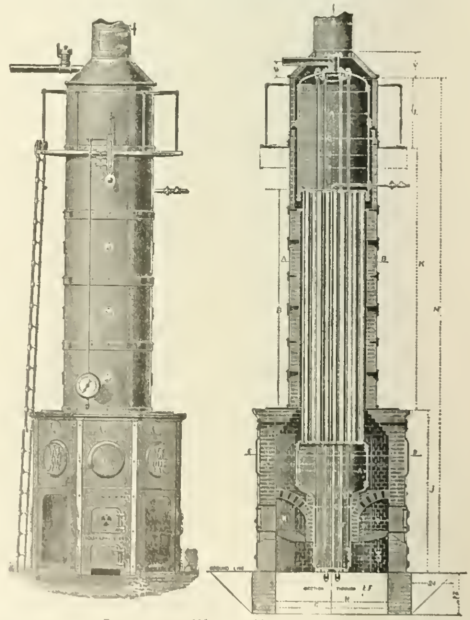
A new type of vertical high pressure water tube safety boiler, which we illustrate herewith, is being placed on the market by the Atlas Engine Works, Indianapolis, Ind., and possesses some interesting features.

The boiler is mounted in an upright position within an enclosing casing lined with fire brick. The lower part is a peculiarly shaped



ELLIOTT-LINCOLN MOTOR.

drum of an inverted bottle form, a central portion of less diameter extending down below the grate, while the main portion is held at a considerable height above the fire. The contracted portion of the lower drum is encased by fire brick. The mid-height of the boiler is a set of vertical tubes. The upper part is a drum in which a liberal surface is presented for the disengagement of the steam from the water. The descent of the water through the central tubes is promoted by a set of telescoping tubes extending the water tubes to near the bottom of the water leg, and which may be slipped up into the water tubes out of the way whenever necessary to enter the water leg for cleaning or repairs. When extended downward so as to be fully efficient, they protect the



IMPROVED WATER-TUBE BOILER.

central set of tubes from being affected by the large volume of steam generated in the exterior portion of the lower drum. The steam generated there rises through the series of tubes above, thus insuring an active upward current of steam and water, and further steam is generated by the circulation of the gaseous products of combustion through the spaces between the tubes. The steam and water thus rising separate

in the upper drum and the steam is conveyed away for use. The water descends through the central tubes of the series, which tubes are over the central portion of the bottom. The small quantity of steam generated in these central tubes is carried down by the descending current, and, moving outward in the lower portion, rises and adds to the velocity of the strong rising columns in the tubes near the periphery of the series.

The non-conducting protection between the central portion of the boiler and the annular furnace which surrounds it, protects the fire from tbeing too much cooled along the inner edge, and allows all portions of he grate surface to be about equally efficient. The fire-brick also preserves that portion of the boiler from being overheated in any exigency.

The annular grate is slightly inclined inward. The annular furnace is fed, cleaned, etc., through doors in the outer casing. A perforated protection of fire brick is extended over the fire at a proper height. At the mid-height of the tubes the masonry wall is extended inward so that it comes nearly or quite in contact with the outermost tubes. The hot gaseous products of combustion deflected inward thereby, are caused to circulate among the tubes. They are afterwards led outward and upward around the exterior of the upper drum and finally collected and conveyed away through a central stack at the top.

New Double Discharge Turbine.

The accompanying illustration represents a new type of turbine wheel, built by James Leffel & Company, Springfield, O., which is simple in form and capable of easy and substantial construction; the wheel shown drives a portion of a large electric plant where several others of the same design and style are in use, under a working head pressure of 90 feet.

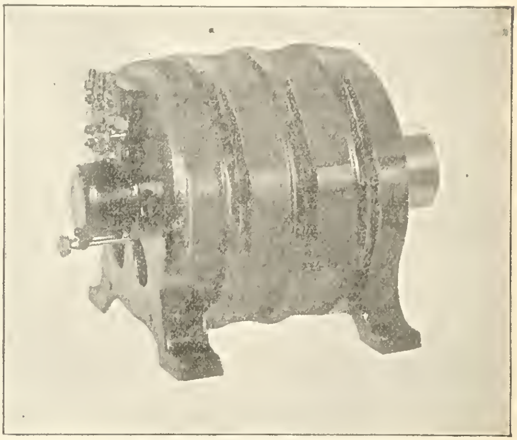
It will be seen that the water enters vertically on the top. The design, however, admits of receiving the water at any inclination from a vertical to a horizontal line. When it enters the outward casing, in which is placed the guide casing of the wheel or runner, the water completely surrounds the latter, under whatever head pressure the wheel is placed, and is admitted to the circumference of the runner or wheel proper through the guides, leaving the wheel after doing its work.

The runner itself is a double wheel, receiving the water from a single set of guides, which surround the circumference of the runner. The wheel is so constructed as to divide the water into two equal portions and discharge it horizontally in opposite directions, on the performance of its work, passing through the curved tubes on each side of the wheel and discharging into the tail water below. This method of application of water to a turbine entirely avoids end thrusts or end pressure of the shaft; in other words it prevents the water from getting between the wheel and any part of the casing, thus avoiding loss of power by relieving the wheel from excessive friction. The wheel illustrated is 30 inches in diameter and of 550-hp capacity. Its regulation is nicely secured automatically, by means of a special governor shown in the cut, thus rendering the wheel highly efficient as a motor for electric light, electric power and various purposes, for which a large number is now in use.

The wheel illustrated has a pulley of 42 inches face and 48 inches diameter, transmitting the whole power through a 40-inch belt to the electrical machinery. The design is essentially the same as that of the two turbines of 1,200-hp, each built for the Cliff Company at Niagara Falls, except that with the latter neither pulleys nor governors are used, the power being applied directly to the machinery at each end of the water-wheel shaft on each side of the turbine.

Small Induction Motors.

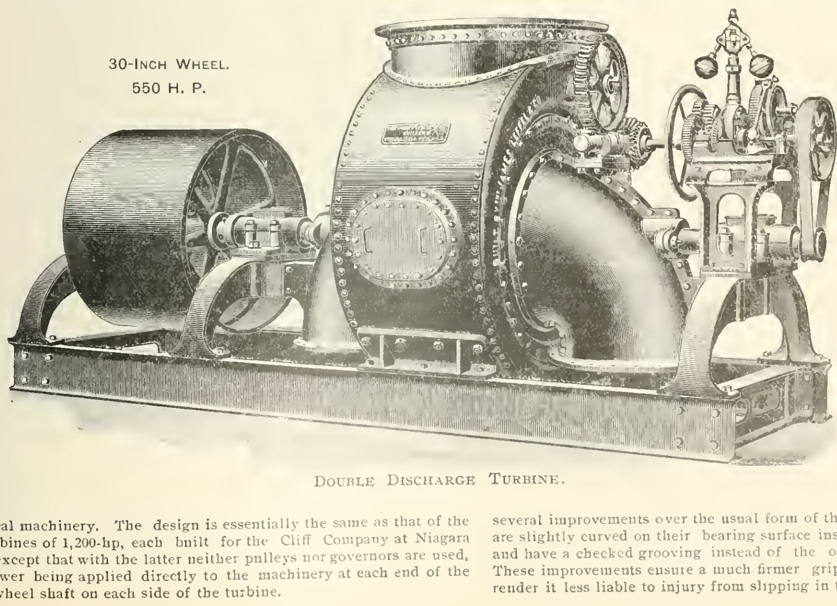
A good example of the smaller line of induction motors which the General Electric Company is placing on the market is that known as the T. I. one-hp, which we illustrate. This motor has been designed to give a powerful starting effort without excessive current. It is almost completely enclosed and may be entirely so if desired. It is totally without moving contacts and the only connection it has with the external circuit is through the binding posts on the outside of the motor. The armature has no connection with the external circuit. Inside of the armature is placed a resistance, only kept in circuit when the motor is first started. The plug shown under the bearing short-circuits this resistance as soon as the armature has attained its speed. The motor is wound for 110 volts, and owing to the simplicity of the winding and the low potential, burn-outs are almost impossible. The absence of commutator and collector rings obviates all danger of sparking and entails the minimum amount of attention in operation. As regards efficiency, uniformity of speed and output per pound of weight, this motor is equal to the best continuous current motors of similar output.



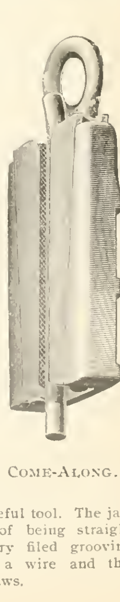
Small Induction Motor.

The Cope Come-Along.

The come-along shown in the accompanying illustration, and made by the Hubley Manufacturing Company, Lancaster, Pa., contains several improvements over the usual form of this useful tool. The jaws are slightly curved on their bearing surface instead of being straight, and have a checked grooving instead of the ordinary filed grooving. These improvements ensure a much firmer grip of a wire and thus render it less liable to injury from slipping in the jaws.



Double Discharge Turbine.



Come-Along.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 27, 1894.

THE ELECTRICAL STOCK MARKET has not kept up either in point of activity or strength to the record of the past few weeks. With the exception of one or two stocks that always will remain speculative favorites by reason of the ease with which their values—or rather quotations—are manipulated, the electric stock list has this week been devoid of stock market interest. It must not be supposed, however, from the lack of transactions, that electrical stocks have lost favor; in their inactivity they are only acting in accordance with the apathy marking the whole Stock Exchange list. The bottom seems really to have dropped out of the stock market. Despite the plethora of money, the investing and speculative public holds totally aloof from stocks; what little there is doing is for the account of eights and quarters scalping professional traders.

GENERAL ELECTRIC alone serves to redeem the electrical stock list from utter lifelessness. In fact, it has been one of the few active spots in the whole stock market, but, as last week, the activity has all been on the bear side, and the stock closes for the week at a considerable loss in quotation. The officials of the company continue to profess their inability to understand the weakness in General Electrics. They aver that no change has come in the good business conditions on which General Electric has held so firm all along, and they insist that a proper appreciation of its present profit-making condition would result in sending General Electric's quotation up instead of down. All the same, the friends of the property fail to back up their spoken belief in its future by giving any support to the stock. Of course, this may not mean that they have less confidence than they talk about, but, when it is remembered that in former times bull talk was always substantiated by big inside purchases, the present indisposition of General Electric's to follow up their talk of big earnings with buying of the stock, is not regarded with much favor. But times and conditions in General Electric have materially changed, and the present course of the management and its friends may be commendable instead of disquieting. As it is, the bears continue to circulate uncontradicted all species of tales reflecting on the company, and, whatever may be their truth, they have surely had the effect of frightening out some long stock. For instance, the bears have put into private circulation a statement showing that there are only $9,000,000 in assets to represent the value of $30,000,000 common stock. No official criticism of these figures has been made public, and the statement has found a lot of believers. Another explanation of the selling of long stock, as given by the Wall Street Journal, is to the effect that the decline in General Electric from 35 was precipitated by the decision of a Boston bank to sell 2,200 shares of the stock which it had had in a loan from 75. Becoming tired, the bank had closed the loan, giving the order to sell the stock to one of the most prominent bear houses in this city. This induced considerable short selling, to an extent that resulted in more long stock coming out.

WESTINGHOUSE ELECTRIC does well to hold its own in this week of declining quotations. Friends of the property continue to extol its prospects once it is in possession of the new plant where it will have everything in the way of improved machinery and methods for manufacturing supplies and apparatus known to the electrical trade. With its low capitalization of about $10,000,000, of which one-half is common stock and less than $1,000,000 in bonds, thus making fixed charges, including preferred stock dividends, very little, not more than $400,000 a year, and with its most economical methods of producing electric apparatus, the hopes of the management regarding future profits seem well founded.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	101¼	102½
" " " Brooklyn	100	109	110
" " " Boston	100	128	130
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	34⅛	34¼
General Electric pref	100	65	70
Interior Conduit & Ins. Co.	100	25	.35
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35½	36
* " " pref	50	52¾	53

BONDS.

	Par.	Bid.	Asked
*Edison Electric Ill., New York	1,000	107[illegible]	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	88	90

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
*American Bell Telephone	100	198	199
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
*Central & South American Telegraph	100	101½	105
*Commercial Cables	100	125	145
Erie Telephone	100	51¾	52¼
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
New England Telephone	100	67	69
Postal Telegraph-Cable	100	54	60
*Western Union Telegraph	100	87	87½

* Ex-div.

AMERICAN BELL TELEPHONE matters are momentarily very quiet, but there is a likelihood that at an early date events are likely to occur that will have an important bearing on the company's future and on the stock's immediate value. There is a disposition to call a special meeting of stockholders within a few weeks to take action on recent legislative matters. It may be tha Stockholders will authorize the sale at auction of $1,000,000 (10,000 shares) of new stock for the sake of experiment. If it is a failure the decision of certain large interests that it is the best for the company to move out of Massachusetts will be materially strengthened. An official says that the "development of the company and its service to the public would be far ahead of what it is to-day had it not been for the restrictions placed upon the company through legislation."

THE ERIE TELEGRAPH AND TELEPHONE interests, since the stock was listed on the New York Stock Exchange, continue to try to excite an artificial interest in the stock by retailing from day to day facts concerning the company's operations and condition. This week's contribution relates that the company has over 6,000 miles of underground wire and that it is steadily extending its metallic circuit system. Treasurer Glidden says that the company's business has made a very material improvement during the past two months. Excepting one or two wash sales, nothing at all has been doing in the stock to mark a result of these endeavors.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES trustees continue to lay aside money wherewith to buy preferred stock. They will receive bids until Oct. 29 for as many shares as $50,000 will purchase.

WESTERN UNION TELEGRAPH stock moves very little either way. In the present dull stock market its fluctations are absolutely without significance.

THE UNITED ELECTRIC SECURITIES COMPANY is also in the market to buy its own bonds; it wants proposals for the sale to the company of as many of its collateral trust 5 per cent. seventh series bonds as can be purchased with $21,000.

NEW INCORPORATIONS.

THE PACIFIC ELECTRICAL COMPANY, San Francisco, Cal., capital stock $30,000, has been incorporated.

THE LONDON ELECTRIC COMPANY, London, Ontario, capital stock $250,000, has been incorporated.

THE JENNEY ELECTRIC CONDUIT COMPANY, Chicago, Ill., capital stock $5,000,000, has been incorporated.

THE WADSWORTH GENERAL ELECTRIC COMPANY, Wadsforth, O., capital stock $10,000, has been incorporated by J. A. Clark and others.

THE PETER ELECTRIC CONDUIT RAILWAY CONSTRUCTION COMPANY, Milwaukee, Wis., has been incorporated with a capital stock of $500,000.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., capital stock $20,000, has been incorporated to manufacture electrical and mechanical specialties.

THE NOKOMIS ELECTRIC LIGHT AND POWER COMPANY, Nokomis, Ill., capital stock $10,000, has been incorporated by George Bliss and others.

THE CITIZENS' GAS AND ELECTRIC POWER COMPANY, Lafayette, Ind., has been incorporated by P. C. Somerville, A. O. Behm and Laban Spraks.

THE PACIFIC ELECTRIC COMPANY, Pacific, Mo., capital stock $5,020, has been incorporated to operate light and power plants. A. H. Brown, A. Kappitz and G. H. Gross, Pacific, Mo., are the interested parties.

THE ECLIPSE ELECTRICAL COMPANY, St. Louis, Mo., capital stock $9,000, has been formed to manufacture electrical appliances. Charles F. Smith, Isidor Fagans and E. C. H. Foelkers, all of St. Louis, are the organizers.

THE TERRE HAUTE AND BRAZIL ELECTRIC RAILWAY COMPANY, Terre Haute, Ind., capital stock $16,000, has been formed to operate an electric railway. Max Joseph, C. F. Miller and J. G. Elder, Terre Haute, are the incorporators.

THE MAGNETIC TELEPHONE COMPANY, Oak Park, Ill., capital stock $100,000, has been formed to manufacture and sell telephones, electrical appliances and machinery. Henry E. Procuiner, George W. Wilson and David J. Kennedy are interested.

THE POLAR STAR ELECTRIC COMPANY, Faribault, Minn., capital stock $50,000, has been formed to manufacture and supply electricity for light, heat and power. Jas. Hunter, Robt. G. Weatherstone and Jas. F. Hughes, Faribault, Minn., are the promoters.

THE KANSAS CITY TRACTION COMPANY, Kansas City, Kan., capital stock $1,000,000, has been incorporated by S. Bird Colen, Brooklyn; W. J. Smith and W. H. Lucas, Kansas City, Mo.; A. W. Trickett, Frank D. Hutchins and C. F. Hutchins, Kansas City, Mo.

THE CHICAGO CENTRAL ELECTRIC RAILROAD COMPANY, Chicago, Ill., capital stock $1,200,000, has been formed to construct and operate by steam or electric power railroads and tramways. Geo. W. Waterman, Wm. R. Odell and Chas. A. Boos, are the promoters.

THE MUTUAL GAS ELECTRIC COMPANY, Brooklyn, N. Y., capital stock $100,000, has been formed to manufacture and supply gas and electricity. A. W. Wannaker, Jersey City, N. J.; Thomas Patterson, Brooklyn, and Chas. H. Selig, New York, are the organizers.

THE MARKS-AYER ELECTRIC COMPANY, Plainfield, N. J., capital stock $350,000, has been formed to generate and sell electricity for light, heat and power, etc. Louis J. Marks, New York, James I. Ayer and Harry G. Runkle, of Philadelphia, Pa., are the promoters.

THE COMONWEALTH ELECTRIC CONSTRUCTION COMPANY, Camden, N. J., capital stock $100,000, has been formed to construct and manufacture dynamos, motors, lamps, etc. L. B. Henry, Eddington; Robt. H. Crozer, Upland and W. Hartel, Philadelphia, Pa., are interested.

THE OHIO ELECTRIC GAS COMPANY, Springfield, Ill., capital stock $250,000, has been formed to manufacture and sell machinery for the purpose of generating gas for illuminating and heating purposes, etc. H. Clay Wilson, Jno. G. Freidmeyer and Benj. Knudson are interested.

THE GOLD BLOSSOM GOLD MINING COMPANY, San Francisco, Cal., capital stock $20,000, has been incorporated to deal in and operate mines, machinery, etc., and also electric light and power plants. Charles F. Reed, Auburn, F. A. Berlin, and Emile Basson, San Francisco, Cal., are the organizers.

THE UNITED STATES TELEPHONE COMPANY, Chicago, Ill., capital stock $75,000, has been formed to construct, operate and maintain telephone and telegraph exchanges; trunk lines for electrical telephone and telegraph purposes; also to manufacture and deal in electrical supplies of all kinds that pertain to its business. Henry S. Perkins, Elias C. Greenlee and Nelson G. Franklin are the incorporators.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, Oct. 29, 1894.

THE R. THOMAS & SONS COMPANY, East Liverpool, Ohio, have opened an eastern office at 39 Cortlandt street, which has been placed in charge of Mr. J. E. Way, who formerly looked after the company's extensive supply business in Chicago.

THE ELECTRICAL & MECHANICAL ENGINEERING COMPANY, 44 Broad street, has closed a contract with the Brooklyn Bridge Trustees for lighting the bridge cars by electricity and furnishing the entire steam and generating plant and distributing system.

MAYOR SCHIEREN, of Brooklyn, has received a petition signed by numerous citizens asking to light the Boulevard from Prospect Park to Coney Island. Major Peter H. McNulty, of Parkville, Supervisor W. B. Bennett, of the Thirty-first Ward, and Mr. James Burrell, of No. 11 Clinton street, Brooklyn, are the prime movers in the project.

MAXWELL M. MEYER, late electrician and superintendent of the Zucker-Levett Chemical Company, Grand street, New York, is about to embark in the manufacturing of dynamos and motors for light and power work. The factory will be at 411 East 107th street, New York, and the business office in the Electrical Exchange. Mr. Meyer is a young man but old in experience, which will no doubt enable him to be a successful competitor in his line.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, October 27, 1894.

MR. H. HUBBELL, manufacturer of machinery and tools, 675 State street, Bridgeport, Conn., reports business as exceedingly good. His specialties are the manufacture of automatic tools, tapping machines and brass machine screws for electrical purposes.

MR. F. W. DAVIS, secretary of the Perkins Electric Switch & Manufacturing Company, of Hartford, Conn., has just started on a Western trip, covering Chicago and all principal Western cities and returning by way of Montreal and other Canadian centers.

MR. NELSON W. TWISS, 28 Whitney avenue, New Haven, Conn., manufaturer of the "Twiss" improved automatic cut-off engine, reports improved business. The "Twiss" engine is especially adapted for isolated plants, and has already received recognition in this direction.

MR. EDRED W. CLARK, 31 Welles street, Hartford, Conn., manufacturer of machinery, and particularly of rubber moulds and rubber machinery, has received some good orders lately for his improved tubing machine for the covering of electrical and telephone cables, which it is claimed has no superior and which is quite generally used by wire and rubber companies.

THE NATIONAL PIPE BENDING COMPANY, of New Haven, Conn., which manufactures the National Feed Water Heater, so well and favorably known generally, not only in this country, but abroad as well, is constructing a new building adjoining its plant, three stories in height and 110x45 feet in dimensions. Col. Simeon J. Fox, treasurer and manager of the company, expects the building to be completed for occupancy about December 1, and is deservedly proud of it.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., is very busy at the present time, working its full force up to 9 o'clock at night, to keep up with its orders. The success of this company is a handsome tribute to the energies of Mr. W. C. Bryant and President Eaton, and considerable credit is also due to Mr. H. A. Hubbell, its cashier and book-keeper, who by his knowledge of the business is able to aid Messrs. Bryant and Eaton and creditably represent them during their absence.

THE NEW HAVEN CAR REGISTER COMPANY, of New Haven, Conn., was the recipient of an unusually large number of orders for its fare registers during the recent Street Railway Convention in Atlanta, Ga., at which it had a splendid exhibit. Mr. F. C. Boyd, vice-president and general manager, and Mr. John S. Bradley, secretary and treasurer of the company, both of whom were in attendance at the convention, are, of course, greatly pleased over the kindly tributes paid their registers by street railway officials and the business recognition it received.

THE PERKINS ELECTRIC SWITCH & MANUFACTURING COMPANY'S new building on Woodbine street, Hartford, Conn., is about completed, and Mr. Perkins expects it to be ready for occupancy shortly after November 1. Mr. Perkins regards his new building with considerable pride, and well he may, for it is certainly a handsome structure. It is three stories in height with an L attached to the main building, which in dimensions is 148x42 feet, the L being 35x50 feet. There are nearly 25,000 square feet of floor space in the building. Abundance of light is afforded in the building throughout, and so far as general appointments are concerned it is most admirably adapted for manufacturing purposes, Mr. Perkins having superintended himself almost every detail of its construction. It is a worthy home for Mr. Perkins' already large and rapidly growing business. Mr. Perkins has considerable ground space adjoining his new factory, and proposes to commence at once the erection of two new buildings one 30x15 feet and the other 20x25 feet.

THE FRISBIE ELEVATOR & MANUFACTURING COMPANY, of New Haven, Conn., is about ready to introduce to the public its new machine for electric elevator purposes, upon which Mr. Frisbie has been busily engaged for some time. It certainly possesses extraordinary merits and advantages, and is a wonderful improvement over its old design of a continuous running motor in one direction. Briefly, its principal features are: That by an ingenious combination of screws and gears the transmission of power to the drum is reversed at the will of the elevator operator; an automatic stop motion renders it impossible for the elevator to travel beyond the top and bottom limits of the well hole; the current required is slight and the machinery runs with very little friction; it operates an elevator with an entire absence of vibration, the starting and stopping being very smooth and gradual, and without any of the unpleasant sensations or jarring so often experienced on high-speed elevators; the elevator, by means of a lever, can be operated with such nicety that it can be started either up or down and stopped or reversed within the space of an inch. While riding in the elevator with Mr. Frisbie he was observed to make a considerable number of rapid reversions of the lever from one extreme to another, the car virtually dancing in the air within the space of about six inches, without any injury to the machine or excessive use of the current. The machine was also made to lift the elevator with one person of nearly two hundred pounds weight to a height of fourteen feet, after the current had been cut out of the motor, the car continuing to run between thirty-five and forty seconds, thus showing the very small percentage of friction on the various parts. These are only a few of the important features of the machine, but enough certainly to demonstrate the exceptional advantages it possesses. Mr. Frisbie uses in connection with his machine the Crescent motor, manufactured by the Crescent Electric Machine Company, of Brooklyn, N. Y., which he regards as particularly adapted for elevator work.

Canadian Notes.

Ottawa, Oct. 25, 1894.

HAMILTON, ONT.—An electric railway between Hamilton and Guelph is proposed.

HAMILTON.—The formal opening of the Hamilton, Grinsby and Beamsville electric railway has taken place.

SEAFORTH, ONT.—A charter has been issued to the Seaforth Electric Light, Heat and Power Co., with a capital of $25,000, for general electric purposes.

OTTAWA.—The Government cable steamer Newfield has been placed at the disposal of the Government cable superintendent, D. H. Keeley, who will commence repairs to the cables between Grand Manan, Campobello and Eastport.

MAGOG.—The town of Magog, Que., has entered into a contract with Mr. Le May to supply arc and incandescent lights for a period of five years. The price for arc lights is $55 per year; for sixteen-candle power incandescent lamps, $5; and for 32-cp lamps $10.

AYLMER, QUE.—This town will shortly be lighted by electricity. R. & W. Conroy have contracted with Messrs. Ahearn & Soper, of this city, for the necessary dynamos, wire, etc. The work of erecting the lines and wiring houses is being done by R. Anderson, electrician, of Ottawa.

OTTAWA.—The Government advertisement calling for tenders for the proposed Pacific cable is attracting outside attention. Mr. T. G. Blackstock is here representing two cable manufacturing companies, one French and the other English, which purpose putting in tenders for constructing the cable.

HULL, QUE.—Theohile Viau, contractor; Jacques P. DeMartigny, banker; Stanislaus Aubry, millwright, of Hull; Charles L. DeMartigny, of St. Jerome; and Alexander Bourgeau, capitalist, of Montreal, are applying to the legislature for an act incorporating them under the name of the Hull Electric Company, with a capital stock of $25,000.

AYLMER, QUE.—T. Viau, contractor of Hull, acting as representative of a private company, with a stated capital of a quarter of a million dollars, has proposed to the Aylmer Town Council a scheme whereby Ottawa and Aylmer are to be connected by electric railway. The company want a bonus of $10,000 and thirty-five years' exemption from taxation.

News of the Week.

Telegraph and Telephone.

KNOXVILLE, TENN.—The People's Telephone Company is making rapid progress in its construction work, under the managmement of Mr. J. C. Duncan. A six hundred-wire switch board and four hundred telephones have been ordered, and 30,000 pounds of wire have been received.

UNIONTOWN, PA.—A charter was granted to the Home Telephone Company, Uniontown, Pa., to maintain and operate a telephone line from Uniontown to Scottdale, to New Haven, etc. The directors are William C. McCormick, Albert Inks, O. J. Sturgis, John K. Ewing, Jr., all of Uniontown, and others.

Electric Light and Power.

HARRISONVILLE, MO.—An electric plant will be established here.

ST. ALBANS, W. VA.—Dana Brothers have put in an electric chain apparatus in their mines.

HONESDALE, PA.—The Honesdale Electric Light, Heat & Power Company's plant will be enlarged.

SPRINGFIELD, MASS.—A forty-foot addition is being built by the electric plant owners at Indian Orchard to accommodate the machinery for an additional 350 lights which are to be put in.

DUNKIRK, IND.—Dunkirk has granted an electric light franchise. The plant is to be completed within 90 days.

DULUTH, MINN.—The Duluth Heights citizens have presented a petition askng for the erection of an electric light plant.

ELON COLLEGE, N. C.—Holt, Gant & Holt are in the market for an incandescent electric light plant of 300 lights of 16-cp each.

DAWSON, GA.—The City Council has ordered an election for November 14, to decide as to issuing $35,000 in bonds to build an electric light plant and water-works.

BUFFALO, N. Y.—A petition from the Niagara Falls Power Company asking a grant to wire the city for the distribution of electric power, was transmitted to the Board of Aldermen.

HUNTINGTON, N. Y.—The Huntington Town Board has been petitioned to create a street lighting district in the village of Huntington. The Board will take action upon the petition Oct. 28.

BELOIT, WIS.—G. L. Call, proprietor of the Beloit Electric Light plant, has been granted a franchise by the Common Council for the construction and maintenance of a telephone exchange.

EVERETT, MASS.—The Everett Aldermen appointed Aldermen Dyer, Cate and Jennings members of the joint special committee to investigate the report on the feasibility of establishing a municipal electric light plant.

NEWTON, MASS.—It is proposed to put the matter of municipal electric light before the citizens of Newton for a decision at the coming city election. If it receives an endorsement at the polls, immediate steps will be taken to secure a plant.

WEST UNION, IOWA.—The vote on the proposition to issue bonds for electric lights was carried almost unanimously. The City Council is looking into the merits of the various plans, and hopes to have everything in shape so that work on the construction can be commenced in a few weeks.

DENVER, COL.—At the meeting of the County Commissioners the Board discussed the lighting of the Court-House, and a committee of three, consisting of Commissioners Nicholl, Kratzer and Wheeler, was appointed to consider the advisability of putting in a large dynamo to relieve the pressure upon the large dynamo now in use lighting the Court-House.

CAPE MAY, N. J.—Supt. James E. Taylor, of the Franklin Electric Light Company, who is also general manager of the South Jersey Railroad, announces that work will be commenced immediately on a $50,000 plant which is to support incandescent as well as arc lights. In the company are Logan M. Bullitt and Thos. Robb, of Philadelphia, Mayor Hildreth and ex-Mayor F. J. Melvin.

BRIDGETON, N. J.—The Light Committee of the city of Bridgeton will receive bids for the lighting of the streets of the city of Bridgeton for a period of five years, from the 13th of December, 1894. Bids must be handed in by noon, October 31. All bids are to be sealed and to be addressed "Bids for Lighting Streets of the City of Bridgeton," and to be sent to Stacy W. Matthews, 72 Pine street, Bridgeton, N. J.

The Electric Railway.

POTTSVILLE, PA.—The Schuylkill Electric Railway Company has been granted permission to extend its lines.

SOUTH FRAMINGHAM, MASS.—The Union Street Railway Company will probably equip its line with electricity.

SCOTCH PLAINS, N. J.—The ordinance has been presented giving the trolley company a franchise to operate a trolley road through the township.

BALTIMORE MD.—Efforts are being made to induce the Baltimore City Passenger Railway Company to extend its electrical line to Westport.

ROCKVILLE, CONN.—The Rockville & Ellington Railway Company is trying to secure a privilege to build its road to the town line beyond Talcottville.

NEWBERRY, FLA—The Victoria Phosphate Company contemplates operating its railroad by electricity. Address J. A. Little, president, at Jacksonville, Fla.

JACKSON, TENN.—The Jackson & Suburban Railway Company, J. H. Hunter, president, will probably soon begin the construction of its electric railroad.

BALLSTON SPA, N. Y.—The Milton Highway Commissioners will meet to consider the granting of a franchise for the Ballston & Rock City Falls Electric Railway.

MINER'S MILLS PA.—The Traction Company surveyors are looking over a proposed route through Main street, of Miner's Mills, to extend to Mill Creek by way of the Bennett colliery.

GRAND ISLAND, N. Y.—It is said that the proposed electric railway around Grand Island will probably be built. Mr. John J. McIntyre, of Niagara Falls, can probably give some information.

NORRISTOWN, PA.—Officers of the Norristown & Chestnut Hill Passenger Electric Railway are in town arranging with the Council for the immediate construction of its line in this borough.

HAMBURG, PA.—The Pottsville & Reading Railway Company has received the right to build and operate an electric railway on certain streets in the borough of Hamburg, County of Berks.

SYRACUSE, N. Y.—The power house of the Syracuse Street Railroad Company will be located on Tracy street in the Third ward. James Stewart & Co. are the contractors. It will cost about $40,000.

A CORRECTION.—In the second line of the fifth paragraph of the paper of Mr. Russell B. Harrison, published in our last issue,a typographical error made "metal cross ties" read "metal glass ties."

WATERTOWN, N. Y.—The street railway company of Watertown proposes to extend its electric road from Brownville to the village of Dexter. The proposed extension is three miles long, and to cost $30,000.

WESTBORO, MASS.—The proposed electric road between Marlboro and that town will run near Lake Chauncey and the hospital. From Westboro another road is proposed to Woodville and Hopkinton.

FAIRFIELD, CONN.—The Selectmen of Fairfield and the officials of the Bridgeport Traction Company have practically agreed on the specifications to be observed in the building of the trolley line to Southport.

PORT HOPE, ONT.—At the request of ex-Mayor Randall, the Council endorsed the report of last year's Council granting the promoters of the electric railway the use of the streets of the town on certain conditions.

BATAVIA, N. Y.—James H. Ahern of New York City, a promoter of street railways was in town endeavoring to interest Batavia citizens in the project of building a trolley road to run from Batavia to Le Roy, the cost to be $200,000.

MOUNT VERNON, N. Y.—The Mount Vernon Common Council has given the Union Electric Railway Company permission to lay double tracks through First street in that city, from Scott's bridge to the terminus at Third avenue.

COWLESVILLE, N. Y.—A trolley line is proposed from Cowlesville to Marilla. A committee appointed to solicit funds are Hon. A. H. Haskins, Charles Hart, W. T. Martin, T. Austin, Grove Barnum, of Cowlesville, and others of the borough.

ORANGE, N. J.—The trustees of the village of South Orange passed the ordinance granting a franchise for an electric railroad from South Orange avenue to the West Orange line to the South Orange & Maplewood Street Railway Company.

AMITYVILLE, N. Y.—South Norwalk capitalists stand ready to build and operate an electric railway across Long Island. Huntington and Amityville will be connected. Mr. Stephen R. Williams, of Amityville, can probably give information.

NIAGARA FALLS, N. Y.—A local paper stated that the contract for building the proposed electric railway to Tonawanda from this city has been let to Sims & Co., and that work would begin immediately. Frank A. Dudley is one of the projectors.

MT. VERNON, O.—The Central Ohio Electric Railway Company has been granted the right of way on the highways of Knox, Morrow and Marion counties, and they are to be connected by an electric railway if the project commenced is carried to completion.

NORRISTOWN, PA.—The Philadelphia & Rosemont Electric Railway Company is acquiring a right-of-way from Philadelphia to Bridgeport. The company desires a franchise over certain streets in Bridgeport, and the matter is in the hands of a committee of Council.

CLARKSBORO, N. J.—A number of men interested in the extension of electric transit in the lower portion of Gloucester county met and temporarily organized a company to build a road from this city to Swedesboro, etc. John S. Somers of Clarksboro, acted as president.

SYRACUSE, N. Y.—Three petitions for street railway franchises from the Syracuse Street Railway Company, the Twelfth Ward Street Railway Company and the Syracuse & East Side Railway Company, were presented to the Common Council and referred to the Highway Committee.

NEW BEDFORD, MASS.—The "Standard" reports that F. S. Stevens, R. T. Davis, Frank Brightman, W. F. Thomas and Benjamin Cook have petitioned for a charter for the Fall River & Providence Street Railway Company, with all of the rights and privileges for building and operating an electric road.

HIGHLAND PARK, MICH.—The Common Council of the village of Highland Park, Wayne county, Mich., on October 15 confirmed an ordinance granting to W. Howie Muir, of Detroit, a franchise to construct an elctric railway, about two-and a half miles long, to be completed and running within twelve months.

BOWLING GREEN, OHIO.—The Council has decided to receive bids for an electric railway franchise within the city limits. E. H. McKnight has made application for the franchise, but it is thought that several other bids will be presented, as other parties are figuring on building an electric road to Perrysburg.

NEWTON CENTER, MASS.—People of Newton Centre met in answer to a call issued by the Newton Center Improvement Association, to connect several routes proposed for street car lines to connect the village of Newton Centre with the Central Boulevard. After considerable discussion it was voted to postpone the consideration of the question.

DETROIT, MICH.—On October 15 the Common Council of Detroit granted a permission to the Detroit Citizens' Street Railway Company to build a temporary single track electric railway from Pallister avenue north to the city limits on Woodward avenue, on the condition that it completes a double track road with girder grooved rails by July 1, next.

ORANGE, N. J.—Mr. F. H. Tidman, formerly of the Edison and Westinghouse companies, has taken charge as superintendent and consulting engineer of the road of the Suburban Traction Company. The company is about to build four miles of overhead pole line, and offers will be considered for hexagonal wood poles, iron poles and about a mile of No. 4-0 feeder wire.

GLOUCESTER, MASS.—The Board of Aldermen met and gave a hearing to the syndicate of capitalists who are planning extensive street railway building in Essex county and on Cape Ann. The petition of the Gloucester & Beverly Street Railway Company for a location (W. B. Ferguson, president of the syndicate) said that the company proposed to run to the Salem line.

WOODBURY, N. J.—A number of men interested in the extension of electric transit in the lower part of Gloucester county met and temporarily organized a company to build a road from Woodbury to Swedesboro, and from Mullica Hill to the Delaware river, etc. John S. Somers, of Clarksboro, acted as president, and James J. Davidson as secretary. Permanent organization will be effected at a second meeting.

LEWISTON, N. Y.—A company, of which Capt. John M. Brinker, of this city is the president, is getting the right-of-way for a double track electric road to be built along the gorge on the American side of the Niagara river, between Niagara Falls and Lewiston. H. Sellers McKee, of Pittsburg, is vice-president of the company, and R. W. Jones, Mr. Brinker's partner in the coal business, is secretary and treasurer.

SAGINAW, MICH.—The project to connect Saginaw and Bay City by an electric railway is under discussion. E. A. Snow, of Detroit, president of the Saginaw Union Street Railway Company, and W. J. Hart, manager of the road, held a conference with the president and manager of the Bay City Consolidated Street Railway in regard to furnishing power and local terminal facilities for the electric road which is to connect the two cities.

CORTLAND, N. Y.,—The Cortland & Homer Traction Company has purchased the equipment for its entire steam plant. Specifications were drawn and contracts placed under the direction of Prof. R. C. Carpenter, of Cornell University. The company will put in four compound condensing Watertown engines, with pumps, condensers, heaters and four 100-hp boilers manufactured by the Watertown Steam Engine Company, of Watertown, N. Y.

BOWLING GREEN, OHIO.—A plan is now on foot to build an electric line between Bowling Green and Perryburg. E. H. McKnight, of Bowling Green, one of the principal owners of the lighting plant at Bowling Green, is back of the scheme. He has recently disposed of a road to Troy, Ohio, and now contemplates connecting Perryburg and Bowling Green. He has secured the right-of-way, with perhaps one exception, between the two towns, and has asked the councils of both towns to grant a franchise.

JOLIET, ILL.—R. B. Campbell, general manager of the Baltimore & Ohio, Baltimore; J. W. Fortune, assistant general manager of the Grand Trunk, and A. J. Green, of Windsor, Ont., were in Joliet looking for investments for the Baltimore & Ohio road. They are taking particular interest in the Joliet Street Railway Company and the Economy Light & Power Company. The probabilities are that the electric street car system will be extended from Lockport to Chicago. The Joliet system will be overhauled at an expense of $60,000. The electric light plant will also be enlarged.

PERSONAL NOTES.

MR. F. S. KENFIELD, of the Street Railway Review, Chicago, was married on Wednesday, October 24, to Miss Amy Sweeney, of Rock Island, Ill. The many friends of the happy couple will join The Electrical World in extending congratulations and good wishes.

THE ENGINEERING PROFESSION of the Pacific Slope is to be congratulated upon the entrance into its ranks of the new engineering firm of Hasson & Hunt, electrical and mechanical engineers. Both of the members of the firm are thoroughly accomplished engineers, not only by education but also through the possession of a wide and varied engineering experience. Mentally they are endowed with the broad caliber and sound judgment characteristic of the higher order of engineering ability, and thus in every respect are thoroughly equipped to successfully undertake the most difficult engineering problems that may come before them. Mr. W. F. C. Hasson, the senior member of the firm, was graduated from Woodward College, of Cincinnati, as gold medallist in 1876, and the same year entered the United States Naval Academy as a cadet engineer. During the course at the Naval Academy Mr. Hasson enjoyed the enviable distinction of being a "star" member of his class, the name being derived from a gold-embroidered star worn on the collar of uniforms, this honor being conferred by the academy authorities for brilliant class standing. Upon graduation Mr. Hasson was ordered to the Asiatic station and at the end of the cruise was detailed for a three-years tour of duty at Colorado University as professor of engineering. At the expiration of this detail he entered upon another tour of naval duty, the trip extending around the world with a lengthy service in Asiatic waters. Upon his return to the United States in 1888 Mr. Hasson was detailed by the Navy Department as an instructor in the electrical engineering course of Johns Hopkins University, and two years later was ordered to San Francisco as an inspector of machinery of the new men-of-war being built there. In 1893 he resigned from the naval service and began the practice of his profession in civil life at San Francisco. Mr. A. M. Hunt, the junior member of the firm, is also a graduate of high standing from the engineering course of the Naval Academy, and, like Mr. Hasson, was highly regarded in the naval service for his professional accomplishments. The intervals between his sea service were mostly spent on special duty, which included one college detail as a professor of engineering. The Navy Department also availed itself of the skill of Mr. Hunt as an expert in steel, and much of his time ashore was spent on duty connected with the inspection of material for men-of-war in course of construction, and in work in the designing branch. When work on the mid-winter fair was begun Mr. Hunt was detailed by the Navy Department to take charge of the mechanical engineering department, where he made a most enviable reputation and, upon the closing of the fair, resigned from the naval service to enter into partnership with Mr. Hasson. The work of Messrs. Hasson and Hunt in connection with the mid-winter fair gave evidence of not only fine engineering ability but of unusual executive talent. The entire execution of the electrical and mechanical portion was left with Mr. Hasson as chief engineer and, with the assistance of Mr. Hunt, the result produced was little short of marvellous when the extraordinary difficulties are considered. The success was entirely a personal one, the large equipment required being obtained by personal solicitation from every imaginable source. Every sort of engineering expedient had to be devised in order to fit the heterogenous assortment of apparatus to each other and the end in view and make the odd combinations serve the desired purpse, and this with an inadequate force of men, restricted funds and an extremely limited time in which to complete the work. Notwithstanding all these discouraging features, on opening day the electrical department was the only complete one of the Fair, and its excellent operation throughout was one of the largest factors in the great success of the exhibition.

W. F. C. HASSON.

A. M. HUNT.

MISCELLANEOUS NOTES.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION has confirmed the action of the Executive Committee at a meeting held in New York September 11, in selecting Cleveland as the place for holding the next convention, on February 19, 20 and 21, 1895.

COMBINATION FIXTURE LITIGATION.—Judge Acheson, of the United States Circuit Court of Appeals, sitting in Philadelphia, on October 22, rendered a decision in favor of the Gibson Gas Fixture Works against George Maitland, the plaintiff in the case. The plaintiff claimed that through two letters patent granted to Luther Stieringer, of whom he was the assignee, for what are called combination fixtures, in which gas and electricity are both used for lighting, he had the monopoly of hanging an electric light on a fixture attached to a gas pipe, whether the fixture was used simply for an electric light or whether it was used for electric light and gas. The patentee claimed he had made an invention by running wires down through the ordinary gas pipe in a fixture used simply for electric lights, or between the iron pipe and the brass casing where the fixture was used both for gas and electricity.

GERMAN INCANDESCENT LAMPS.—The Marinette, Wis., "Eagle" says that the manager of the Wright Lumber Company at Merrill, Mr. H. W. Wright, was recently solicited by an agent of a German house, who offered to deliver incandescent lamps in Merrill at a price eight cents apiece less than Mr. Wright could buy them for anywhere in the United States and pay his own freight. The "Eagle" becomes somewhat excited over this intelligence, and demands that a duty of eight cents be placed on foreign lamps to prevent American manufacturers of lamps from closing their works or reducing wages to a level with those of Germany.

Trade and Industrial Notes.

FOWLER & M'VITIE, of Galveston, Tex., have established a branch at Tampico, Mexico, with Mr. Howard Carnes in charge.

THE STAR DYNAMO COMPANY, Jefferson, Mo., has issued a catalogue describing and illustrating the Star dynamo. This machine is designed especially for use in isolated and private plants, and with a special view to wearing qualities.

THE BROWN & SHARPE COMPANY, Providence, R. I., in a recent pamphlet gives a number of excellent half-tone illustrations, printed upon a fine quality of wood-cut paper, of cutters, mostly special patterns. From the introduction we learn that this firm manufactures no less than eight hundred and forty-nine sizes of stock cutters.

THE LOUISVILLE ELECTRICAL WORKS, Louisville, Ky., has recently been giving considerable attention to the manufacture and sale of patented inventions. This branch of its business is growing with gratifying rapidity and with the anticipated revival in business in the West will undoubtedly reach large proportions.

W. H. HORNBERGER, Elkhart, Ind., has sold his entire interest—including patents—in the Hornberger Electric Manufacturing Company to Mr. J. C. Boss. Mr. Hornberger founded the above company nearly five years ago, and by keen business sagacity and the determination to manufacture a transformer of high merit, soon placed his company in the front rank of electrical manufacturers.

THE MICHIGAN ELECTRIC COMPANY, 47 State street, Detroit, Mich., illustrates and describes in a 22-page catalogue the well-known "Michigan" electric railway specialties. All of these fittings have been designed by men who have been continuously engaged in the construction and operation of electric railways since 1888, and therefore specially fitted from their practical knowledge for the work.

THE C. W. HUNT COMPANY, 45 Broadway, New York, has issued a handsomely illustrated and printed catalogue under the title of "Coal Handling in Power Stations," in which many equipments for this purpose are shown and described. The pamphlet has largely the character of a technical treatise on the subject, and will be found of much interest by engineers and power-house and central station managers.

CHARLES A. SCHIEREN & CO., 45 Ferry street, New York, have received a letter from electrical engineer, Alfredo De Rosenzweig, of Guanajuato, Mexico, under date of October 12, reading as follows: "In November or December, 1893, I bought five perforated electric leather belts from you, each fifteen inches wide, for an electric plant of this city. These belts are giving excellent satisfaction, and I know of no better class of belting for use in electric light work."

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., reports the outlook as encouraging. It has recently shipped its dynamos and motors to Louisville, Ky.; Jeffersonville, Ind.; Dallas, Tex.; Elgin, Ill.; Dayton, O., and Cleveland, O., besides several plants sold and erected in Cincinnati. Its plant is running full time and inquiries are coming in very fast. The general public are becoming more familiar with the many excellent features embraced in The Triumph design.

THOMAS H. FOOTE, for the past four years connected with the Waddell-Entz Company, has opened an office as consulting electrical engineer in Harlem, No. 215 W. 125th street. Mr. Foote will make a specialty of installing isolated plants, electrical testing, etc. Previous to his connection with the Waddell-Entz Company, he was with the Edison Company, at Schenectady, for three years, and was superintendent of their testing room for some time The last year and a half he was superintendent of the storage battery plant at Second avenue in this city, for the Waddell-Entz Company

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, has evidence of return to better times by the numerous orders it is receiving in tempered copper and its celebrated batteries. The demand for the Imperial Dry Battery is increasing, so that it is with great effort able to supply the sudden increased demand. The electrical trade is finding out that the Imperial has stood the test of the trade and scientific experts for the past two years, and the company challenges the world to produce its equal. Its tempered copper is securing a reputation second to none on the market. It will shortly introduce to the trade something entirly new in this line.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., reports that among recent orders received for its pressure regulators to be applied to dynamo engines are two four-inch for the United States battle ship "Texas"; one five-inch for the United States armored cruiser "Brooklyn"; one three-inch and one four-inch for the United States armored cruiser "Indiana"; five seven-inch for the Providence Steam Engine Company; two eight-inch for the Corliss Engine Company, of Providence, and one four-inch for the Western Union Telegraph Company's building. The latter is to deliver steam to three dynamo engines, and to meet specifications is required to maintain within one pound a uniform delivery pressure of 45 lbs. regardless of change of initial or boiler pressure, which ranges from 60 to 100 lbs., and regardless of change of load or number of engines in operation.

Business Notices

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 23, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

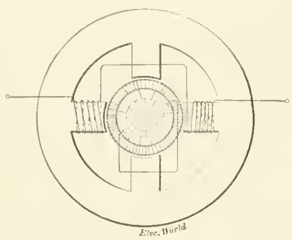
527,766. METAL BRUSH FOR DYNAMOS: W. Von Braucke, Thmerterbach, Germany. Application filed July 2, 1894. This consists of a large number of thin threads of copper laid loosely si le by side and held together by a metal wire cloth.

527,776. ELECTRIC MOTOR OR DYNAMO; C. P. Daniels, Macon, Ga. Application filed Dec. 2, 1891. This comprises field magnets separate and independent of each other, each magnet consisting of two parts connected by curved and angular bars.

527,785. RAIL BOND; W. A. Granten, Hartford Conn. Application filed June 7, 1894. This consists of a body having a threaded shank with a hollow end, and a plurality of wire grooves, the outer walls of the grooves being formed by outward extending ears, and a bonding wire grapped by the ears.

527,786. SELF-WINDING ELECTRIC CLOCK: E. G. Hammer, Brooklyn, N. Y. Application filed July 13, 1893. This comprises a circuit-closer consisting of two vertically sliding pins one above the other, normally our of contact, and a mechanism in connection with the clock movement for lifting the lower pin into contact with and to lift the upper pin.

527,788. ELECTRIC UTERINE BATTERY; C. E. Hebard, Grand Rapids, Mich. Application filed July 11, 1894. This comprises an inner perforated tube,



No. 528,121.—ALTERNATING CURRENT MOTOR.

a solid outer tube, a zinc head for one tube and a silver flange at the other end thereof, and the two conneted by a copper ribbon

527,823. CLOSED CONDUIT ELECTRIC RAILWAY; J. F. McLaughlin, Philadelphia, Pa. Application filed April 5, 1894. This comprises a travelling magnet above the conduit, a circuit closing trolley in the conduit carrying an armature for the magnet, and lugs in the conduit between the magnet and armature and constituting stationaty polar extensions of the magnet.

527,857. TRANSFORMER SYSTEM FOR ELECTRIC RAILWAYS; M. Hutin and M. Leblanc, Paris, France. Application filed Nov. 16, 1892. The combination with the vehicle, of a stationary primary circuit extending longitudinally and carrying alternating currents of high frequency, and a secondary circuit carried on the vehicle and including a secondary coil, and means for suppressing the self-induction of said coil.

527,839. ANNUNCIATOR SIGNAL; I. H. Farnham, Wellesley, Mass. Application filed Feb. 23, 1894. This comprises an auxiliary circuit, a periodic interrupter therefor, a series of circuit closers, and an auxiliary signal device included in the auxiliary circuit and requiring for its operation the concurrent action of the periodic interrupter and some one of the circuit closers.

527,840. SUPPORT FOR TROLLEY WIRES; F. C. Fisk, Buffalo, N. Y. Application filed March 1, 1894. This consists of twin parts having similar inclined grooves which register with each other to form an inclined passage, and a sleeve adapted to surround and carry the line wire and provided with inclined flanged wings adapted when brought together for sliding and wedging engagement with the inclined passage.

527,861. METHOD OF MANUFACTURING ELEMENTS OR PLATES FOR SECONDARY BATTERIES: H. F. Kirkpatrick-Pickard & H. Thame, London, England. Application filed Jan. 10, 1894. This consists of melting separately galena and metallic lead, mixing the same and pouring the mixture in a molten condition into a heated metallic mold.

527,864 CARBON HOLDER FOR ARC LAMPS: E. Lavens, Brooklyn, N. Y. Application filed March 17, 1894. This comprises two plates having angular portions and fitted together so as to be capable of sliding lengthwise relatively thereto, and means for adjusting the plates relatively to each other.

527,874. CLOSED CONDUIT ELECTRIC RAILWAY; J. F. McLaughlin, Philadelphia, Pa. Application filed May 24, 1894. This comprises electro-magnets hung from a motor car and free to tilt and to swivel in a horizontal plane.

527,901. ELECTRIC ARC LAMP: H. O. Swoboda, New York, N. Y. Application filed March 2, 1894. This comprises a movable carbon support, a controlling device, a solenoid, a tilting frame connected with the core of the solenoid, mechanism carried by the tilting frame and connected with said controlling device, a pin pivotally connected with the balance lever, a spring for holding the pin in normal position and a projecting pin supported by a stationary part of the lamp for co-acting with said pin of the balance lever.

527,920. TROLLEY WIRE SUPPORT; M. M. Wood, Chicago, Ill. Application filed April 30, 1894. The combination of a bracket arm provided with a hook at one end and a span wire support at the other end.

527,927. ELECTRIC MOTOR FOR RAILWAY CARS; N. C. Bassett, Lynn, Mass. Application filed June 28, 1893. An electric motor geared to and centered upon a car axle, and supported upon a supplementary frame pivotally connected at one end of the truck, and spring supported at the other end.

527,958. ELECTRIC SIGNALING SYSTEM; B. A. Fiske, U. S. Navy. Application filed May 13, 1892. This comprises a transmitting instrument containing a cylinder, circuit head, pivoted arm thereon provided with a contact point, conductor, supported on the periphery of the head and insulated therefrom, and an electrical indicating instrument within the cylinder, the cylinder having an opening through which the instrument may be seen.

527,947. METHOD OF AND MEANS FOR CONTROLLING ELECTRIC CARS: H. P. Davis, Pittsburg, Pa. Application filed March 29, 1894. This consists in connecting two motors on the car in series, cutting out one of the motors, connecting the two in parallel with resistances and diminishing the resistances in series with the two motors successively, the resistance in series with the motor previously cut out being the first cut out.

527,989. COMBINED REGULATING INCANDESCENT LAMP AND SOCKET: C. A. Hussey, New York, N. Y. Application filed May 14, 1894. This comprises two filaments having their ends joined in a common terminal at one side, and disconnected and insulated terminals at the other side, a circuit controller having a pair of normally open spring contacts in circuit respectively with the insullated filament terminals, other spring contacts in circuit respectively with the common and one of the insulated terminals, and a rotary contact piece carrying a cam adapted to connect the filaments in series, singly, or in multiple, with the circuit mains.

528,014. ELECTRIC SWITCH; J. F. McLaughlin, Philadelphia, Pa. Application filed May 6, 1893. This comprises a rotary spring actuated switch block, a lock for holding the block against the action of the spring, and a winding key for the spring.

528,021. ELECTRIC LIGHTING SYSTEM; G. T. & G. J. T. J. Parfitt, Keynsham, England. Application filed July 12, 1892. In a multiple series circuit, each of the branches of the main lines having a separate electro-magnet and light connected in series, and each of the branches having a resistance circuit around the lamp, and each of the magnets adapted for operating a switch to bring the resistance into multiple with the lamp circuit when an excess of current passes through it, and to break the resistance circuit when the lamp circuit is broken, or when no excess of current passes through the lamp circuit.

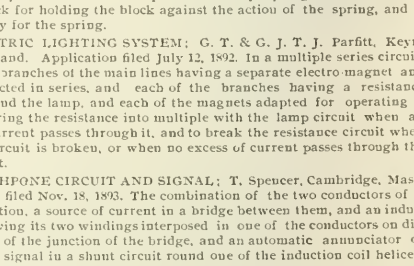
528,040. TELEHPONE CIRCUIT AND SIGNAL; T. Spencer, Cambridge, Mass. Application filed Nov. 18, 1893. The combination of the two conductors of a link connection, a source of current in a bridge between them, and an induction coil having its two windings interposed in one of the conductors on different sides of the junction of the bridge, and an automatic annunciator or other visual signal in a shunt circuit round one of the induction coil helices.

528,053. MAGNETIC SEPARATING MACHINE; W. H. Williams, Newark, N. J. Application filed June 27, 1891. The combination with a pair of magneto-electric poles arranged pole to pole, of a non-magnetic drum rotating within the magnetic field between the poles.

528,054. MAGNETIC SEPARATOR: W. H. Williams, Newark, N. J. Appplication filed Jan. 29, 1892. The combination of two cores and helices arranged end to end with their poles adjacent, and a yoke joining the cores and central thereto.

528,075. COMBINED TELEPHONIC AND SIGNALING SYSTEM; H. A. Chase, Boston, Mass. Application filed June 25, 1894. This comprises a main line circuit with transmitting and receiving devices, a shunt circuit around a controller for said main line circuit, a telephonic apparatus in the shunt circuit under control of the main line circuit controller, and a second telephonic apparatus as the receiving station under control of a circuit controller at said receiving station.

528,101. TROLLEY WIRE SWITCH PLATE; G. A. Huben, Springfield, O. Application filed Feb. 23, 1894. The combination of a metallic frame having



No. 527,823.—CLOSED CONDUIT ELECTRIC RAILWAY.

an enlarged opening, and a trolley wire entering the same, and elastic cushions arranged on each side of the trolley wire.

528 119. ELECTRIC ARC LAMP; S. Bergmann, New York, N. Y. Application filed April 6, 1894. The combination of a movable carbon support, a notched wheel deriving motion therefrom, and a contact piece bearing against the wheel and caused to shift its position by the notch of the wheel.

528,121. ATERNATING CURRENT MOTOR; C. T. Child, Ashland Va. Application filed Dec. 22, 1893. An alternating current motor consisting of secondary coils in close relation to masses of iron between the alternating and opposite poles of the field magnet, to reduce the current in the armature coils by the alternating current in the field coils.

528,122. AUXILIARY SIGNALING SYSTEM FOR RAILWAYS: M. S. Conly, Chicago, Ill. Application filed March 6, 1890. This comprises a series of stationary signals in circuit, a primary coil in the circuit, a secondary coil and circuit carried by the engine, a battery and signal also carried on the engine, the battery being arranged to operate the signaling device upon the passage of the secondary coil through the magnetic field of the primary coil of the track signal.

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CONTENTS.

AMERICAN MANUFACTURES EXHIBITION.

The movement in favor of holding exhibitions of American manufactures, first in the City ol Mexico and later in the chief South American Republics, is gathering strength, and arrangements are now being completed to hold a convention of manufacturers in order to perfect the necessary details. The plan, which has met with the hearty approval of President Diaz, of Mexico, also includes the joint display of the products of the Spanish-American Republics, thus imparting an international character to the exhibitions and largely enhancing their interest and value for achieving the end in view. That such exhibitions would accomplish a good end cannot be doubted, and we trust that the efforts of the energetic and patriotic gentlemen at the head of the enterprise will result in a most complete success.

ELECTRIC LIGHT GLOBES.

The Digest of this issue contains an account of a new electric light globe recently invented in France which, from the description, appears to represent a notable improvement, and deserves careful attention, particularly on account of the great extension it promises to the use of the arc in interior lighting. It will be seen that by a proper proportioning of the exterior horizontal and interior vertical corrugations any desired distribution of light can be obtained; thus, for interior lighting a uniform diffusion is possible and the question of a proper distribution of light in street illumination is solved. At first sight it would seem that with this system absorption might reach a serious figure, but it is stated that with the corrugations so designed as to avoid total reflection, the loss may vary from only nine to thirteen per cent., which is less than what has sometimes been observed with plain glass globes, some figures in the latter case being as high as twenty per cent.

PRACTICAL COMPOUNDING OF DYNAMOS.

In many text books the subject of compounding of dynamos is so involved through the introduction of equations, curves and the introduction of extraneous considerations, that the student often has difficulty of clearly understanding what is really a simple matter. Those who have encountered any difficulty in understanding the subject will find that the article by Mr. George T. Hanchett, which we print elsewhere, puts the matter in a simple and entirely practical manner. In connection with the subject of over-compounding the student should also consult the article on this subject by Prof. E. P. Roberts, which appeared in a recent issue, as it is there shown that where dynamos are connected in parallel, the dynamo compounds only for the current passing through its armature, with the consequence that with a light load on the line, but with part of the dynamos switched off and the others under full load, the over-compounding will cause an excess of E. M. F. at the lamps. It will be understood that the remarks of Mr. Hanchett are based upon the presumption that the magnetic circuit of the dynamo has been properly designed; that is, that a proper relation exists between the magneto-motive force and the reluctance, so that the magnetization is carried at a point that justifies the considerations mentioned.

FLY WHEEL ACCIDENTS IN POWER HOUSES.

In this issue we publish several further interesting contributions to the instructive discussion on fly wheels which has been appearing in our columns, and also print the first part of an exhaustive article by Prof. Flather on the subject of fly wheel accidents in general. Mr. Coykendall still insists upon the importance of the tangential stress due to a sudden change of load, and which some of those who have taken part in the discussion have confused with the tangential component of the centrifugal force. We cannot agree,

however, that the former is the same kind of stress as that due to centrifugal force, and that from it an accident may occur in the same way as from the latter. The tangential component of the centrifugal force produces a strain in the rim of a fly wheel of the same character as that produced by steam pressure in the shell of a boiler. The strain produced by the sudden imposition of a load and consequent sudden change of speed, however, is in the nature of a shearing strain as far as the rim itself is concerned, and would appear to be of such an order as to be entirely negligible in the rim. On the other hand the stress on the pulley arms due to this cause may be excessive. If weakest at the junction of the rim, the arms thereby may be sheared at the rim, though it is much more probable, on account of the influence of leverage, that they will part at some point between the hub and the rim. If, however, the fly wheel is also used as a driver, in case of a sudden imposition of load the additional strain of the belt would reduce the strain on the arms, as the pull of the belt would be opposite to the leverage on the arms due to the stress arising from change of momentum of the rim. The main point made by Mr. Coykendall —that a sudden change in the momentum of a fly wheel may produce a sufficient stress to fracture the arms—seems to be unquestionable. Nevertheless, it is probable that centrifugal stress due to increased speed is by far the more prevalent cause of fly wheel accidents.

CABLE ROADS.

An article in a London electrical contemporary of high standing, in which a comparison is made between electrical and cable roads, concludes that "in the case of street tramways it will be difficult to find any method of haulage which, with a fair traffic, can be operated more economically than the cable system." A good illustration showing that this conclusion is not correct, at least not in this country, is a case in Philadelphia in which city two of the most important lines are soon to be changed to electric roads that for a number of years have been operated by cable. Although they were very unsatisfactory to citizens, this cannot be said to be the reason for the change, a company like the owners of these roads considering the dollars and cents only, and it may therefore be safely assumed that it has assured itself that the profits would be greater, notwithstanding the increased capital required and the almost total loss of the cable machinery and conduits. It is said that the conduits are rotting although they are not many years old. Whether the difference between the results in England and America are due to the poor construction of electric roads there, or to the poor construction of cable roads here, remains to be determined, but at all events the conclusions quoted above ought not to be assumed as applying equally well here. If in the above quotation the words "will be" are replaced by "was not" it will apply to this country. In justice to the cable system it might be remarked that in both of these Philadelphia lines there are but few steep grades and it is on lines with heavy and frequent grades that any possible advantage of the cable system becomes more apparent. As we write it is announced that two important cable roads in Chicago are also to be changed to electric roads.

THE ELECTRICAL TRANSMISSION OF POWER.

In this issue we begin a series of articles from the pen of Dr. Louis Bell on the electrical transmission of power, which, we think we can say with confidence, will be of a value to the electrical fraternity comparable to that other notable pioneer work, "The Electric Railway in Theory and Practice," of which Dr. Bell was a joint author. It will be remembered that at the time the latter work appeared the state of knowledge on the subject of street railway theory and practice bore a great resemblance to the present condition of knowledge concerning the electrical transmission of power. As far as the more practical questions are concerned, the condition is even more unfavorable with respect to the latter, as information on the practical part of the subject has been confined to very few persons, none of whom has heretofore shown any particular desire to impart it to the public. While much has been written on the theoretical side, it has been fragmentary in character and in most cases so highly mathematical and so largely lacking in a practical basis of fact as to have little other than an abstract interest. The electrical public is to be congratulated that Dr. Bell has undertaken the task of treating the subject in a definitative and comprehensive manner, and with particular reference to its practical engineering features. His professional connection with this branch during the last several years, during which time he has been a potent factor in its development, united with a thorough grasp of all of the higher principles concerned, and the possession of a most lucid and graceful literary style, all give assurance of a work that will occupy a high place in engineering literature. As will be seen, the subject is introduced by an exposition of the elementary electrical principles concerned, and it will be noted that Dr. Bell's treatment is founded on the very latest conceptions, being much in advance of the usual text-books in this respcet. The exposition will be a logical one, and all of the points taken up turn that are necessary to a thorough understanding of the important questions to be met in practice, but theory will be introduced only as a means of attaining a practical end. The illustrations for the series will be carefully prepared, largely from original sources, and in every direction no pains will be spared to make the work one that will answer in every respect the need that now exists for a thorough treatise on this most important and growing branch of electrical engineering.

Magnetic Qualities of Gun Steel.

The October number of the "Journal of the United States Artillery" contain a contribution from Lieut. Geo. O. Squier, U. S. A., on "Some Tests of the Magnetic Qualities of Gun Steel." The article embodies the results of a series of experiments recently made in the laboratory of the Johns Hopkins University. The steel was a muzzle-ring from a 3.2-inch breech-loading rifle cut from the gun as the last operation, and therefore furnishing a sample of the physical condition of a finished gun. The steel originally came from the Bethlehem Iron Company, of Bethlehem, Pennsylvania, and is a low steel of remarkable physical qualities, forged, oil tempered and annealed. The results of the tests are here given in the author's own words:

"The very superficial tests made indicate that the steel of our new guns, besides possessing remarkable physical qualities, also has excellent magnetic qualities, and, but for the cost, could be used for the construction of electrical machinery with very efficient results. In fact, a comparison of the $\mathfrak{B}$ $\mathfrak{H}$ curve with Hopkinson's curve for the best wrought iron shows them to be practically the same in character, and when further compared with the curves for the average steel castings from various manufacturers in the United States, we find magnetic values about 8 per cent. in favor of gun-steel. This indicates an improvement produced by forging as compared with simple steel castings, and for marine dynamos, and in gun-training motors where space is valuable, steel of high permeability will, probably, be exclusively used in the future.

"Passing to the hysteresis behavior, it was observed that the hysteresis curve is of the characteristic 'square-shouldered' type, which is often found in steel and almost always in annealed soft iron. This bend in the curve, which is not a decided 'knee' in this case, divides the curves into parts corresponding to the stable and unstable conditions in Ewing's theory. The rate of descent from the bend during the reversal of the magnetism is remarkably rapid and uniform, while the comparatively small area inclosed shows the effect of annealing. Hardening steel increases hysteresis loss so that samples with exactly the same chemical constitution show very different losses, depending upon whether they have been annealed or hardened.

"From data which has but recently come to hand, it would appear that there is a connection between the magnetic qualities and the physical conditions of steel as indicated by a combination of high physical qualities; for instance, nickel-steel, possessing in an unusual degree a combination of high elastic limit and ductility, is also found to possess exceptionally high magnetic permeability."

Day load.

At the opening of the central station at Worcester in England, the advantages of electric cooking were shown by cooking a number of the dishes at the banquet by an electric current generated by the waterfall three miles distant; the indirect object was to advertise electric cooking in order to increase the day load.

Electrical Power Transmission—I.

BY LOUIS BELL.

Concerning Electrical Energy.

1. It has long been the fashion to speak of what we are pleased to call electricity as a mysterious "force" and to attribute to everything connected with it occult characteristics better suited to mediæval wizardry than to modern science. This unhappy condition of affairs has, in the main, come about through indistinctness of some of our fundamental ideas and inexactitude in expressing them.

To speak specifically, there has been even in the minds and writings of some who ought to know better, a tendency toward confusing the somewhat hazy individuality of "electricity" with the sharply defined properties of electrical energy. We have been so overrun by theories of electricity, two-fluid, one-fluid, and non-fluid; with electrically "charged" atoms and duplex ethers, that we have well nigh forgotten the very great uncertainty as to its concrete existence. Even admitting it to be an entity it most assuredly is not a force mysterious or otherwise. Electrical force there is, and electrical energy there is, and with them we can freely experiment, but for most practical purposes "electricity" is merely the factor connecting the two. It is related to electrical energy much as that other hypothetical fluid "caloric" was supposed to be related to heat energy. The analogy is not exact but it nevertheless expresses a distinct idea.

The day has passed wherein we were at liberty to think of "electricity" as flowing through a material tube or as plastered upon bodies like a coat of paint. The things with which we have now to deal are the various factors of electrical energy.

It is the purpose of this chapter to treat of that form of energy which we denominate electrical, to discuss its relation to other forms of energy and the transformations which they may reciprocally undergo.

2. Speaking broadly, *energy* is power of doing work. The energy of a body at any moment represents its inherent capacity for doing work of some sort on other bodies. This, however, must not be understood as implying that the aforesaid energy is limited by our power of utilizing it. We may or may not be able to employ it to advantage or under possible conditions. As an example take the massive weight of a pile driver. Raised to its full height it possesses a certain amount of gravitational energy—a possibility of doing useful work. This energy is temporarily unemployed and appears only as a stress on the supporting rope and framework. Under these circumstances, wherein the energy exists in static form, it is generally known as *potential* energy.

Now let the weight fall and with swiftly gathering velocity it strikes the pile and does work upon it, settling it deep into the mud. The energy due to the blow of the *moving weight*, energy of motion in other words, is called *kinetic*. But at the bottom of its fall the weight still has potential energy with reference to points below it, and we realize this as the pile settles lower and each successive blow becomes more terrific. At some point we are unable further to utilize the fall, and have then reached the limit of the *available* energy in this particular case.

We must not forget, however, that each time the weight was lifted, work had to be done against gravitation to give the weight its point of vantage with respect to available energy. This work was probably done by expending the energy of expanding steam—in other words, the energy of the steam has been transformed through doing work on the piston into kinetic energy of the latter, which, through doing work against gravitation, has been enabled again to reappear as the energy of a falling body, and to do work on the driven pile. And back of the steam energy is the heat energy, by which work is done on the water in the boiler, and yet back of this the chemical energy of the coal transformed into heat energy and doing work on the minute particles of iron in the boiler, for we now know that heat is a species of kinetic energy.

Even the work done on our pile is not permitted to go untransformed into energy. Part is transformed into heat energy through friction and compression, part into friction of the water, and tiny waves that may lift against gravity chips and pebbles on a distant shore. Other fractions go into the vibrational energy of sound, heating the weight so that it gives out warmth—radiant energy—to the hand when held near it, and the surrounding air, and electrical work done on the weight and neighboring objects, for the weight unquestionably receives a minute amount of electrical energy at each blow. Thus a comparatively simple mechanical process involves a long series of transformations of energy.

3. No energy is ever created or destroyed, it merely is changed in form to reappear elsewhere, and work done is the link between one form of energy and another. And we may lay down another law of almost as serious import. *No form of energy is ever transformed completely into any other.*

On the contrary the general rule is that with each transformation several kinds of energy appear in varying amounts, and among them we may always reckon heat. The object of any transformation is usually a single form of energy, hence practically no such thing as perfectly efficient transformation can be obtained. The energy by-products for the most part cannot be utilized and are frittered away in useless work or storing up kinds of potential energy that cannot be employed.

The greatest loss is in heat which is dissipated through space and cannot be recovered.

Heat is therefore the worst enemy of efficiency.

From what has gone before we can readily appreciate that when we do work with the object of rendering available a particular kind of energy, the method must be intelligently selected else there will result useless by-products of energy which will seriously lower the efficiency of the operator.

Whenever possible we utilize potential energy already existing to secure a transformation. Thus if heat is wanted, the easiest way of getting it is to burn coal, and allow its energy to become kinetic as heat. If we want mechanical work done, we set heat energy to work in the most efficient way practicable. If electrical energy is desired we set the energy of steam at revolving the armature of a dynamo. If the right method of transformation is not taken, much of the energy will turn up in forms we do not want or cannot utilize. Burning coal is a very bad way of getting sound, just as playing a cornet is but a poor means of getting heat, although a fire does produce a trifling amount of sound, and a cornet by continual vibration must be warmed in a minute degree.

These seem, and perhaps are, extreme instances, but when we realize that, somewhat to the discredit of human ingenuity, only one twentieth of the electrical energy supplied to an incandescent lamp appears in the form of light, the comparison becomes grimly suggestive.

4. Understanding now that in order to obtain energy in any given form (such as electrical) particular methods of transformation must be used in order to secure anything like efficiency, we may look a little more closely at various types of energy to discover the characteristics that may indicate efficient methods of transformation, particularly as regards electrical energy.

Speaking broadly, one may divide energy into three classes:

1st. Those forms which have to do with movements of, or strains in, masses of matter. In this class may be included the ordinary forms of kinetic energy of moving bodies and the like.

2nd. Those which are concerned with movements of or strains in the molecules and atoms of which material bodies are compared. In this class we may reckon heat, latent and specific heats, energy of gases and perhaps chemical energy.

3rd. All forms of energy which have to do with strains which can exist outside of ordinary matter, i. e., every kind of radiant energy and presumably of electrical energy.

These classes are not absolutely distinct; for example, we do not know the relation of chemical energy to the third class, nor of gravitational energy to either, but such a division serves to keep clearly in our minds the kind of actions to which our attention is to be directed.

It is only within the past few years that we have been able with any certainty to classify electrical energy, and even now much remains to be learned. For a very long while it has been known that light, i. e., luminous energy, must be propagated through a medium quite distinct from ordinary matter and possessing certain remarkable properties. It was well known that luminous energy is transferred through this medium in vibratory or wave motion. Even the period of the vibrations and the lengths of the waves were accurately measured, and from these and similar measurements it has been possible to classify the mechanical properties of this medium, universally called "the ether" until we really know more about them than about the properties of many kinds of matter—a number of the rare metals for example.

The next important step was the discovery, verified in the most thorough manner, that what had been known as radiant heat, such as we get from the sun or any very hot body, is really energy of the same kind as light. That is, it was found to be energy of wave motion of precisely the same character and in the same medium, differing only in frequency and wave length. It also has turned out in similar fashion that what had been called "actinic" rays, that are active in affecting a photographic plate and

producing some other kinds of chemical action, are only light rays of shorter wave length than usual, and so ordinarily invisible to the eye.

5. So much having been ascertained it became clear that instead of three kinds of energy—"heat, light and actinism," we were really dealing with only one—radiant energy, vibrating energy in the ether, varying in effect as it varied in frequency. Speaking in an approximate way, such wave energy has a frequency of *six hundred thousand billion* vibrations per second and a velocity of propagation of about a hundred and eighty-five thousand miles per second, so that each wave is not far from one fifty-thousandth of an inch long. These dimensions are true of light waves; chemical action can be produced by waves of half the length, while so called heat rays may be composed of waves two or three times as long as those of light. Such figures are startling but they can be verified with an accuracy greater than that of ordinary mechanical measurements.

We see that this radiant energy is capable of producing various disturbances perceptible to our senses, such as chemical action, light and heat, and that these different effects simply correspond to waves of energy having different frequencies. This being so, it is not unnatural to suppose that at still different frequencies other effects might be noted. This idea gains further probability from the experimental fact that waves of very different frequencies traverse the ether with precisely the same velocity, showing no signs of slowing up or dying out, so that there seems to be no natural limit to their length.

6. During the past half dozen years it has been clearly shown that "radiant energy" is capable of producing profound electrical disturbances, such as violent oscillations of electrical energy in conducting bodies, and that these effects exist whatever the frequency of the ether waves concerned. This very important fact was clearly foreseen by Maxwell nearly twenty years ago, regarding light, and his prediction has been thoroughly verified through the persistant researches of the late Prof. Hertz and others.

This discovery is often expressed by saying that radiant energy is an electro magnetic disturbance, or that light is one kind of electrical action. It is more strictly accurate to say that radiant energy, just as it produces chemical disturbances on the photographic plate, affects the eye as light, and material bodies as heat, is also capable of producing electrical effects when transferred to the proper media. Most of our experiments on its electrical effects have been performed with waves many thousand times longer than those of light, but their general character has proved to be exactly the same.

A given substance may be differently related to waves of radiant energy of different lengths, but the phenomena are still essentially the same. For instance, a plate of hard rubber is thoroughly opaque to waves of a length corresponding to light, but is quite transparent to those of considerably greater length, such as can produce thermal or electrical effects. A plate of alum will let through light waves and very long waves, but will stop most of those which are efficient in producing heat. A sheet of metal is quite opaque to all waves of radiant energy. Hence, the fact noted long ago by Maxwell, that all good conductors are opaque to light although the converse is not true.

5. The substance of all this is, that the same sort of disturbance in the ether that produces light is also competent to set up electrical actions in material bodies and conversely, such actions may and do produce corresponding disturbances in the ether which are thus transferred to other bodies. Such a transference corresponds to all that we know concerning the velocity with which electrical and electro magnetic disturbances pass from body to body. It is equally certain that this velocity totally transcends anything we could hope to obtain from bodies having the dynamical properties of ordinary matter, while it does fit exactly the dynamical properties of the ether.

6. We are thus forced to the conclusion that when an electrical current, as we say, "passes along" a wire, whatever a "current" may be, it is not passed along from molecule to molecule in the wire as sound or heat would be, but that there is an immensely rapid transfer of energy in the neighboring ether that reaches all points of the wire almost simultaneously. It takes a measurable time for the electrical energy to reach and utilize the centre of the wire although its progress over the surface, thanks to the free ether outside, is immensely rapid.

Thus takes place what is generally called a "flow of electricity" along the wire. Looking at the process more closely, the nearest approach to flow is the transfer of energy along the wire by means of stresses in the ether which set up strains in the matter along their course.

Whenever we cause in matter the particular stress which we call electromotive force for lack of a more exact name, the resulting strain is electrification, and if the stress be applied at one point of a conducting body, the strain is immediately transferred to other points by the stresses and strains in the surrounding ether. Wherever this transference of strain exists we have an electrical current, although this name is generally reserved for those cases where there exists a perceptible transference of energy by the means aforesaid. If the conditions are such that energy must be steadily supplied to keep up the electromotive stress we have such a state of things as we find in a closed circuit containing a battery.

7. To cause such a flow of energy we must first find means of setting up electromotive stress capable of being propagated through the ether. Now atoms and molecules are the only handles by which we can get hold of the ether. In so far as we can work on them we can do work on the ether.

As a matter of fact we cannot do work of any kind on the molecules of a body without setting up electrical stresses of some sort. In most cases of mechanical work, which in the main produces stress on the molecules only by strains in the mass, the energy appears mainly as heat, and is only incidentally electrical, as for instance in the radiant energy from a heated body.

When, however, by any device we do work more directly on the molecules of a body, or on the atoms which compose the molecules, we are more than likely to transform this work into some manner of electrical energy. As a rough example of the two kinds of action just mentioned, pounding a body heats it without causing any considerable electrification, while on the other hand rubbing it even gently, sets up a considerable electrification without heating it noticeably.

In fact, for many centuries, friction was the only known method of causing electrification. Later, as is well known, it was discovered that certain sorts of chemical action, which has to do directly with interchanges of energy between molecules, were very potent in electrical effects. With this discovery came the ability to deal with steady transfers of electrical energy in considerable amount, (electric currents) instead of the relatively slight and transitory effects previously known, (electrification "frictional" electricity).

8. To clear up the real nature of this difference it is well to consider what we mean by saying that a body is electrified, or has an electrical charge. In other words, what is electrification? Not very many years ago this question would have been answered by saying that a quantity of a substance, positive electricity (or negative as the case might be), had been communicated to the body in question; that this remarkable substance could reside only at the surface of the body and was able to produce in surrounding bodies exactly an equal quantity of negative electricity; that this "charge" of electricity would repel another "charge" of the same substance placed near it, or attract a charge of its opposite, the other substance called negative electricity; and much more to the same effect. All this was a very convenient hypothesis,—it explained, after a fashion, the common facts and enabled investigators to discover many electrical relations and laws. But it expressed much more than there was reason to know. From the standpoint of our modern doctrines of energy electrification is a very different thing.

9. Let an electromotive stress (of whatever source) be applied to a body, a metallic sphere for example, long enough to transfer to it a finite amount of energy. This energy appears as stresses and strains in the ether everywhere about the body under consideration and thence extends to the molecules and atoms of neighboring bodies causing "induced charges." It is as if one were to fill a box with jelly, and then pull or push or twist a rod embedded in its centre. The result would be strains in the rod, the jelly and the box, and in a general way the total stress on the box would equal that on the rod. By proper means we could detect the strain all through the substance of the jelly, but most easily by its variations from place to place.

We do not know exactly what sort of a strain in our ether jelly is produced by electromotive stress, but we do know that it possesses the quality of endedness, so that the strains in the matter concerned, i.e. the ball and surrounding bodies, are equal and opposite.

In fact the two "charges" are merely the two ends of the same strain in the ether. They appear to us to be real attributes of the two opposed surfaces, because at these surfaces the dynamical constants, such as density, elasticity, etc., of the medium, through which the strain is propagated, change in value, and differences in state of strain there before manifest.

(To be Continued).

ELECTRIC SYSTEM OF THE PHILADELPHIA TRACTION COMPANY

BY HERMANN S. HERING.

IV.

A rather novel feature in the car equipment is the Engineer's test car, which is furnished with testing instruments and is used to inspect the lines and to make various car tests. This car, which is numbered "999," and whose motors and trucks are identical with the regular 16 ft. car, is painted a dark red color to distinguish it from the other cars on the lines, and has a special folding step, which is opened or closed by the opening or closing of the platform gate. The purpose of this is to prevent any passengers from attempting to board the car while it is in use.

The interior, shown in Fig. 27, is handsomely finished and provided with easy chairs. The instruments are arranged on and below a shelf shown on the right hand side. On the shelf is a Weston 600-volt voltmeter and 100 ampere ammeter and the switches for controlling the circuits. Below the shelf is a Thomson recording

FIG. 27.—INTERIOR OF TEST CAR.

wattmeter and a Boyer Railway Speed Recorder, the dial of which is placed above the shelf. The tubing shown on the right side is a large U tube filled with mercury, with which the grades can be determined, and on the left side of the rear door is a column in which a counterweight moves and indicates the height of the trolley wire. Fig. 28 is a diagram of the connections of the instruments on the shelf. *A* is the ammeter; *B*, a switch for short-circuiting the ammeter; *C*, a double-throw switch for the purpose of connecting the ammeter in the circuit of a car coupled to the test car; *D*, a short-circuit switch for the wattmeter, and *E*, the voltmeter, connected between the trolley wire and ground. The ammeter circuit is arranged on the ground side of the motors, that is, it is put between the ground connection of the motors and the ground, in order that no shock can be obtained by any one touching the instruments. This car has been used considerably by the Board of Directors and it has become so popular that they have ordered a "Directors' Car," to be built by Pullman.

Fig. 29 is a view of the electric street sprinkler, which is rather a new feature in electric railway work. It is used on the suburban roads, where so much dust is raised by the cars going at a high speed and has worked very successfully during the past season. It is equipped with two 30-hp motors, and holds 2,700 gallons of water, and can run 15 miles an hour when sprinkling.

Fig. 30 is a view of one of the six tower wagons used by this company. They were designed by Mr. J. E. Lloyd, the assistant engineer, and consist of a telescoping framework of iron which can be raised by means of a windlass to suit the height of any trolley or guard wire in the city. It is supported on a wagon with a large wheel base which is also supplied with a full complement of tools and materials for making repairs on the lines, in the conduits or on disabled cars, and also carries screw jacks, ropes, etc., to provide for accidents. Fig. 31 is a view of the tower wagon with the platform raised. The design is very ingenious and these tower wagons are probably the most complete in every detail that have ever been constructed. They are kept ready at all times for immediate service, and the company is contemplating the installation of a general alarm and call system extending over all of the lines, by means of which the tower wagons can be summoned by the motor man or conductor without the delay of telephoning. The plan is to place call-boxes at short intervals along the road, which will connect with the main station, the signal being sent there first and then transmitted to the station nearest the trouble.

LOAD DIAGRAM.

The output of station B, 13th & Mt. Vernon streets, for 24 hours, is shown in the diagram, Fig. 32 Readings of the bus-ammeter

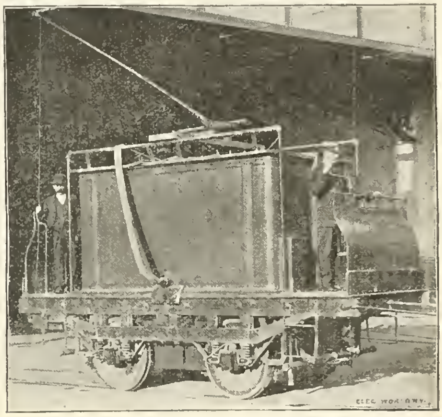


FIG. 29.—ELECTRIC STREET SPRINKLER.

were taken every two minutes and plotted on a time base and an average line drawn. This curve shows the load for a typical day, being neither a very heavy nor a very light one. The continual variations of the current were comparatively small, as they should be in such a large plant, and the variation during the day corresponds closely to the number of cars operated. It has been found that the average current required per car, is about 10 amperes, which is a fair figure considering that the grades are all very small.

The pressure used on the system is about 515 volts, and the larg-

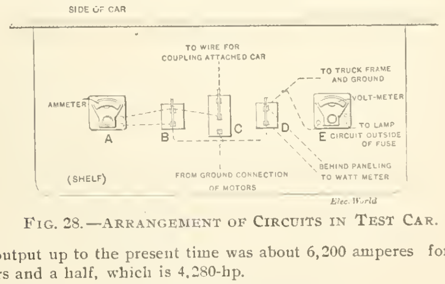


FIG. 28.—ARRANGEMENT OF CIRCUITS IN TEST CAR.

est output up to the present time was about 6,200 amperes for two hours and a half, which is 4,280-hp.

THE ENGINEERING STAFF.

Portraits of the members of the engineering staff are given in Fig. 33, and a brief account follows of their past records and the work they have charge of at present.

Mr. Fritz Uhlenhaut, Jr., Chief Engineer of the Electrical Depart-

ment, is known as an authority upon electric railway work. For several years he has held prominent positions, among which may be mentioned that of Electrician of the Edison Electric Illuminating Company, of Brooklyn, and engineer in charge of construction for the Field Engineering Company, of New York. Mr. Uhlenhaut was born in New York City; he is a graduate of Stevens' Institute of Technology, taking the degree of mechanical engineer in 1888. He is a pioneer in electric railway construction in Philadelphia, having built the first electric road in that city. He now has about one hundred miles of road completed and two hundred and ten miles under his supervision, all of which is the very best that modern practice can suggest and reflects great credit upon him as well as upon his able corps of associates. One of the causes of Mr. Uhlenhaut's success is his executive ability and his policy of dividing the administration of the details of the various departments among a corps of thoroughly capable assistants, who are held responsible for the departments under their supervision. Mr. Uhlenhaut succeeded Mr. F. W. Darlington, who made the original designs of a portion of the system.

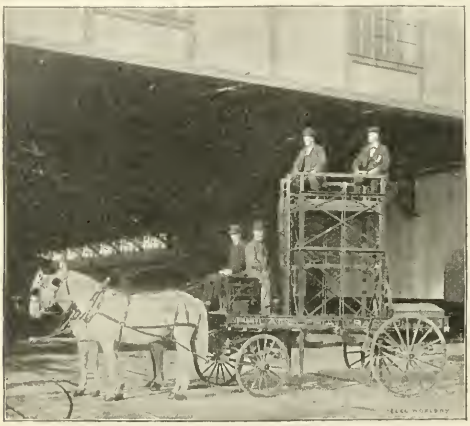


FIG. 30.—TOWER WAGON.

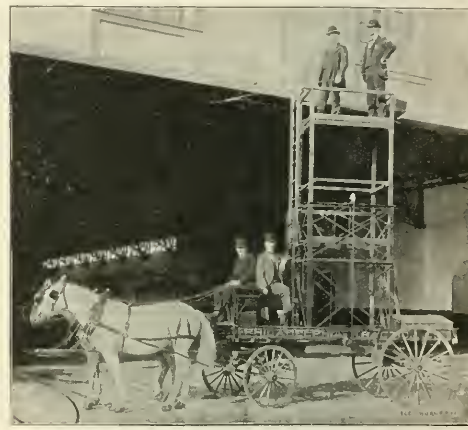


FIG. 31.—TOWER WAGON, PLATFORM RAISED.

Mr. J. T. Gorman, general superintendent of the Philadelphia Traction Company, which position he has filled since 1881, is well known among street railway companies. He has had a thorough and practical experience in all of the various branches of street-car work prior to his promotion to the position of general superintendent, and is well fitted for the important position which he now fills so well. Mr. Gorman is an "up to date" man, thoroughly posted in modern railway affairs, and the successful operation of this extensive railway system is evidenced by his ability and worth as a general superintendent. His motto is "Keep the cars moving."

Mr. J. E. Lloyd, the assistant engineer, was born in Pittston, Pa., in which city he was brought up with mechanical training. He has held the important position of chief engineer of the Pittston Electric Light and Illuminating Company, and of the Wilkesbarre West Side Electric Railway, and was with the Field Engineering Company when building the Catherine & Bainbridge street railway, which latter he resigned to accept the superintendency of the electrical department of the Buffalo Railway Company. From there he returned to Philadelphia to accept a position with the Philadelphia Traction Company, in June, 1893, as superintendent of the station at Sutherland avenue, and after the completion of the Power Station at 13th and Mt. Vernon streets, he was appointed superintendent of the latter as well as of the lines operated from this plant. Considerng the many cross lines and the intricate switches and cross-overs, the good condition in which these lines are always to be found speaks well for his ability and close attention to their maintenance.

Mr. W. D. Gharky, superintendent of the underground cable department, was born in Ohio and received an ordinary school education in the city of Portsmouth of that state. He took up the study of telegraphy and afterwards became identified with the telephone service, having, in 1886 and 1887, installed the electrical plant in two of the largest public institutions in his native state. After this he became connected with the Edison United Manufacturing Company, and subsequently with the Edison Electric Illuminating Company, of Brooklyn, in their underground construction department, and was soon promoted to the position of superintendent, having charge of their entire underground system. He resigned this position in 1890 to take a similar one with the Field Engineering Company, of New York, and constructed subway and cable systems for this company in the cities of Detroit and Buffalo. He has the distinction of installing the first underground feeder cable which proved a commercial success in the operation of an electric railway. In August, 1893, he was engaged by the Philadelphia Traction Company and has had charge of their underground feeder system and its construction since that time.

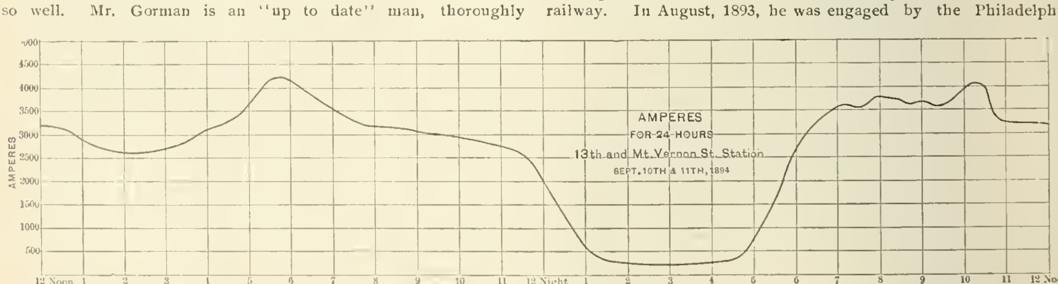


FIG. 32.—OUT-PUT DIAGRAM, MT. VERNON STATION.

Mr. S. H. Harrington, in charge of the construction department, is a native of Baltimore. Having gone through a mechanical course with the Baltimore & Ohio Railroad Company, he was transferred to the civil engineering department of the same road; the latter position he resigned to take charge of the drawing department of the Pennsylvania Railroad, Southwest system. He left the Pennsylvania Company to accept the position of consulting engineer with the Consolidated Coupler Company and the Gould Coupler Company; later on he was mechanical engineer for the Erie system, and still later held a similar position with the C., C., C. & St.

Railway, and in May, 1893, entered the services of the Philadelphia Traction Company. His thorough mechanical experience, original ideas and natural inventive genius eminently fitted him for the position which he occupies.

Mr. J. E. Grist, in charge of the steam operating department, was born in Boston, England, and came to this country when a boy. He indentured himself as an apprentice at the works of the B. W. Grist & Company, Ltd., of Reading, Pa., where he served his apprenticeship until the age of 21, and then worked two years as a journeyman, after which he was promoted to foreman of the shop, holding this position for some time; later he was promoted to be superintendent of the Pennsylvania Iron Works Company, in which capacity he remained until January 1st, 1894, when he resigned to open an office as consulting engineer, in the Betz Building, Philadelphia. Soon after, however, Mr. Grist was offered, and accepted, the position which he now holds in connection with the general direction of the machine shop of the company.

Mr. O. W. Durgin, superintendent of subway department, was born in Boston, Mass. His knowledge of subway work has been quite extensive. He was with the Metropolitan Company during 1884 and 1885 and with the New England Telephone Company from for three months and spent one month on the road "installing" for this company.

Mr. R. D. Allen, superintendent of the line construction, was born in Philadelphia. He graduated in 1890 from the Philadelphia Manual Training School, and the following year took the post-graduate course in electrical engineering. He then entered the services of the J. G. Brill & Co. Car Works as superintendent of the electrical department, resigning there in 1893 to take his present position with the Philadelphia Traction Company.

Mr. C. G. Grant, supervisor of track bonding, who is a native of Augusta, Maine, has had considerable experience in his particular line of work and in electrical matters generally, and he entered on his present engagement in May, 1893.

Mr. J. A. Barclay, superintendent of the Sutherland Avenue Power Station, is a native of Greensburg, Ind., and graduated from the University of Nebraska. In 1892 and 1893 he had charge of the electric street railways of Evansville, Ind., and in the latter part of 1893 he entered the service of the Philadelphia Traction Company as assistant superintendent of the Sutherland Avenue Station; in December of the same year he was promoted to superintendent, which place he now holds. Mr. Barclay has a thorough knowledge

FIG. 33—PORTRAITS OF THE ENGINEERING STAFF.

1885 to 1893, at which time he was employed by the Philadelphia Traction Company. His experience has admirably fitted him for the responsible position which he has filled during the past eighteen months.

Mr. W. I. Kimball, first assistant in the underground cable department, is a native of Philadelphia. His education was begun in Rugby Academy and finished at Kingston, N. Y., where he graduated in 1889. In March, 1890, he entered the employ of Chadbourne, Hazelton & Co., electric railway contractors, and while with this company he was engaged in the construction of the North Avenue Electric Railway, Baltimore, which was the first electric railway built in that city, and also on the Neversink Mountain Road, Reading, Pa. In October, 1890, he entered the University of Pennsylvania to take the special one year course in electrical engineering, and in the spring of 1892 became associated with the Field Engineering Company, of New York, and was employed in the construction of the Catherine and Bainbridge Streets Railway, the first electric road constructed in Philadelphia. He also worked in the shops of the Westinghouse Electric Manufacturing Company of station work and line maintenance and he has successfully managed the station of which he has charge.

Mr. C. P. Wilson, superintendent 33rd and Market streets Station, was born in Indianapolis, Ind. He completed the Indianapolis High School course in 1888, entered Cornell University and graduated therefrom in 1892 with the degree of mechanical engineer, having given special attention to the electrical course. He subsequently assumed charge of the drawing department of the Indianapolis Training School, but resigned to take a position with the Citizens' Street Railway Company of the same city, remaining with the latter until the acceptance of his present position in April, 1894. The successful operation and orderly appearance of the station under Mr. Wilson's charge is evidence of his ability.

In conclusion the author desires to express his obligation to all the members of the engineering staff for the information concerning this railway system, but especially to the Chief Engineer, Mr. Fritz Uhlenhaut, Jr., and his assistants, Messrs. J. E. Lloyd, Wm. D. Gharky and S. H. Harrington for their invaluable assistance in the preparation of this article.

Cable vs. Electric Traction.

We recently announced that two of the cable roads of Philadelphia are to be changed to trolley roads, and as we go to press the announcement is made by the Yerkes Chicago Street Railway Syndicate that it has also decided to substitute electric traction on its cable roads.

Practical Compounding of Dynamos.

BY GEO. T. HANCHETT.

If a shunt machine running at constant speed is required to supply a current to its load-circuit, a certain drop of voltage occurs below that which it gives when running at no load, provided that no rheostat or other means of adjustment have been used to rectify it. This drop of voltage is very nearly directly proportional to the current drawn from the armature, and is due principally to the fact that the extra volts needed to force the increased current through the armature itself are taken from the electromotive force of the machine and apparently disappear from the terminals, and also because the drop of voltage from this cause deprives the magnet of a proportional amount of current and hence weakens it. The armature of the machine loaded with many ampere turns acts as a magnet in opposition to the field magnet, and this tends to weaken the field and hence drops the voltage.

The electromotive force of any one dynamo depends upon two things, namely, its speed and the strength of its magnetic field. These volts thus generated are used for two purposes: First, to force the current through the external circuit; second, to force the current through the armature. Hence we see that if we demand of an armature an increased current we must provide extra volts to drive this current through the armature, if we wish constant potential at the terminals. Since the speed of the dynamo is constant we must therefore increase the strength of the field.

If the armature has re-actions and thus cuts down the field we must provide additional strength to overcome this, also. Knowing the resistance of the armature, it is perfectly possible to calculate the number of extra volts necessary to force any current through it, but it is by no means so easy a matter to calculate the re-active effect of the armature on the field, for this depends on the winding of the armature, the position of the brushes (a variable), the shape of the pole pieces, the quality of the iron and many other considerations.

Many writers have deduced complex formulæ which are supposed to take all these factors into consideration, and at the close of the demonstration say that owing to certain assumptions, which are not exactly in accordance with the conditions of practice, they are only useful in showing the mathematical theory of compounding. If used carefully and intelligently these are of value, but the practical method here described is also useful.

The strength of the magnetic field of a dynamo depends upon the number of ampere-turns surrounding its magnetic circuit. Hence if we wish to increase the strength of the magnetic field, we must increase these ampere-turns. It is obvious that a shunt coil cannot do this, for when unaided the current in it diminishes when the load comes on.

If, however, we have a coil which we can connect in series with the main circuit, it will increase in its magnetizing power as the load comes on. We know how strong the main current will be at full load, but we do not know the additional ampere turns necessary to keep up the voltage. Therefore we cannot compute the number of turns this coil should have. To practically determine the magnetizing power of both shunt and series coils of a compound dynamo, place on the magnetic circuit coils of a known number of turns, all in series. Start the dynamo and separately excite these coils till the machine comes up to voltage. Then draw from the armature the number of amperes which it proposed to use in exciting the shunt field of the completed machine. This is usually two to five per cent. of the full load current. Increase the current in the exciting coils till the machine is again at rated voltage, readjust the current in the armature if necessary, multiply the reading of the ammeter in the exciting circuit by the total number of turns of the exciting coils, and the result will be the proper magnetizing power of the shunt coil in ampere-turns at no load. Continue to increase the current in the armature of the machine till the rated load is attained. Increase the current in the exciting coils till the rated voltage of the machine is reached, being careful to keep the current load the same. This voltage is usually from three to five per cent. more than the voltage at no load, because the machine should be *over-compounded* to make up for the loss in the line. The product of the ammeter reading by the number of turns in the exciting coil, will give the total number of ampere turns necessary, and the difference between this number and the ampere turns necessary for the shunt, plus its increase due to over-compounding, will be the number of ampere turns required for the series coils.

Divide the last named quantity by the rated current of the dynamo and the result will be the number of series turns required. This will be better illustrated by a practical example.

Suppose that we wish to compound a 33-kilowatt Edison shunt dynamo capable of supplying 320 amperes at 105 volts, at 750 revolutions per minute. Suppose that we wish to adjust it for 5 per cent. loss in the line. Suppose that on the field magnet are 3,260 turns, and that at no load a rheostat has to be inserted in series with the fields.

Start the dynamo, separately exciting the field, and allow it to come up to voltage at no load, 105 volts, having an ammeter in the shunt circuit. Suppose this current to be for simplicity's sake 5 amperes. Since in this case we propose to use our "experimental field coil" for the actual shunt field coils in the completed dynamo, we must draw from the armature five amperes, and see if the voltage of the machine is cut down. If this is the case we must mutually adjust current drawn from the armature and exciting current till they are both the same and the voltage of both 105. A good method in this case is simply to allow the dynamo to excite itself and when the rated voltage is reached take the shunt ammeter reading. Then separately excite and continue. Suppose that this adjustment results in a current of 5.1 amperes. The ampere turns on the magnet are then $5.1 \times 3,260 = 16,626$. Now increase the main current to full load, 320 amperes. The voltage will drop. Increase the exciting current till the voltage comes up to 105 + 5 per cent. of 105 = 110.25 volts, being careful not to let the main current increase while so doing. Now read the ammeter of the exciting coils again, and suppose it now reads 6.3 amperes.

The total ampere-turns are $6.3 \times 3,260 = 20,538$. From this we must subtract the ampere-turns of the shunt at full load. At full load the shunt supplies five per cent. more ampere-turns than at no load, due to the fact that it is subjected to 5 per cent. more voltage; hence this is 16,626 + 5 per cent. = 16,626 + 831.3 = 17,457.3.

The ampere-turns for the series coils are $20,538 - 17,457.3 = 3,081$. Dividing this by the main current, we have the number of turns required, $\frac{3,081}{329} = 10$ turns nearly. We therefore wind five turns on each limb of the magnet and connect them in series.

It is possible to use this method in the case in hand without separate excitation, but for simplicity's sake and also to make the case more general, separate excitation was considered.

As the series coils are simply regulators for the re-actions of the armature and the lost volts consumed in driving the current through the armature, the excellence of the design of a machine is, roughly, inversely proportional to the number of turns on the series coils, for the lost volts and armature re-actions of a good machine are very small.

A machine may be heavily over-compounded or have a number of series bobbins in parallel, and in such a case, when applying this approximation, due allowance must be made.

Electric Light from Spring Power.

Our contemporary, Lightning, in referring to a recent English advertisement of a dynamo for house lighting, driven by a spring which is wound up, remarks that "the idea of lighting a house by a dynamo driven by clockwork is too delicious to keep to oneself." Although to day the idea may be ridiculous with electric lights of such poor light efficiency, yet when the generation of cold phosphorescent light by electrical means is an accomplished fact, and from present appearances it may become so before many years, it will not be absurd to talk of generating light for a small house by means of a wound up spring.

Welsbach vs. Electric Light.

In discussing the Welsbach burner the London *Electrician* remarks that "one of the distinct advantages of electric lighting, which it is impossible to estimate in money value, is the convenience of switching on or off without having to hunt for matches; but with a Welsbach burner a spirit lamp or electric lighter is recommended. The one is, of course, generally empty, and the other almost invariably out of order; but, of course, such trifles are no obstacle to the publishing of startling comparisons between costs of lighting by this bilious looking contrivance and by electric glow lamps."

Notes on the Management of Railway Power Stations—V.

BY GEORGE T. HANCHETT.

The Generator.

The construction of a well made railway generator is such as to enable it to stand a good deal of abuse with regard to sudden changes of load. When one looks at the ammeter of a railway switchboard and sees the needle swinging back and forth some times in sweeps of 150 amperes or more, and knowing that each ampere means nearly a horse power, the severe changes of load are very forcibly called to mind. For the reason that a railway power station often has to bear severe overloads due to disabled machines,

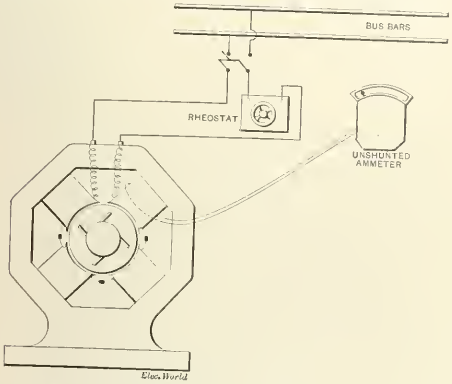


FIG. 15.—METHOD OF DETECTING SHORT CIRCUITS IN FIELDS.

the station engineer should find out by experiment just how much overload each machine can carry at its limit. There will be times when trouble will come and an intimate knowledge of the powers of each machine will be the only means by which the difficulty can be intelligently met.

In the writer's opinion the testing of a generator for overload capacity should be with the idea of developing latent defects. A good railway generator should stand 75 to 100 per cent. overload for an hour at a time. To test a machine for this choose a time when the station load is sufficiently heavy for the purpose, and gradually turn the rheostats of the other machines down till their load comes off them all but twenty to thirty amperes and then throw the double pole switch. Keep the machines turning over at the full voltage ready for instant service. The machine now subjected to the overload should be carefully watched. The station ammeter should be under strict observance and it would be well to have another generator attached to the bus bars. By means of the

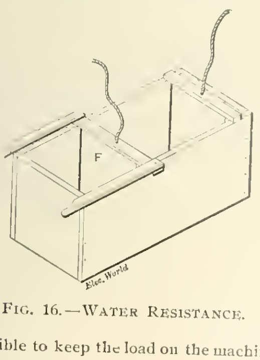


FIG. 16.—WATER RESISTANCE.

rheostats it is possible to keep the load on the machine that is being tested fairly constant.

The eyes, ears and nose should be kept wide open. Ammeter readings should be frequently taken and the behavior of the brushes carefully noted. At the close of the test throw the load on the other machines and shut down. Take the temperatures of the field commutator and armature by placing the bulb of a thermometer upon them and covering the same with a piece of waste. The highest reading should be taken, and should not be over 110 F. above the temperature of the engine room. The load of a station can be made much less trying to the generators if the motormen are carefully instructed. When a circuit breaker is thrown every motor on that line comes to a standstill before the current is thrown on again. On replacing the circuit breaker the heavy starting current of all the motors will probably throw it again, unless, as is too often the case, it is held in by a broomstick. The motormen with odd numbers should be instructed to start first, followed, one or two minutes later, by the even numbers. A defective coil on a generator of the ring or drum type need not necessarily disable a machine. Be sure this coil is open circuited and plug in between the bars to which it is attached with copper wedges. If a mistake is made and a good coil short-circuited, that coil will promptly burn out. A machine will operate for several days with one or more defective coils plugged in this way.

The writer has used the following method of detecting short-circuited or partially short circuited field bobbins. Take the terminals of a Weston station ammeter from its shunt and bring them down by light wires to the machine to be tested. Connect the field magnets of the machine to the bus bars, and with the rheostat choke down the current to a very small amount. Loop a single turn of wire around one of the good field bobbins and connect it onto the terminals of the ammeter and quickly break the field circuit. The ammeter needle will give a sudden kick. Be careful to so connect the ammeter as to have this kick deflect the needle over the scale. Having done this always open the ammeter circuit while you close the field switch. Adjust the current till on breaking circuit a good deflection is obtained. The defective bobbin, on being treated in this way, at once reveals itself by its relatively smaller deflections. (See Fig. 15.) Better results may be obtained by short circuiting all but the bobbin tested and reducing the current in proportion. An ammeter in the field circuit is now necessary to produce comparative results.

The Weston station ammeter deprived of its shunt is a most deli-

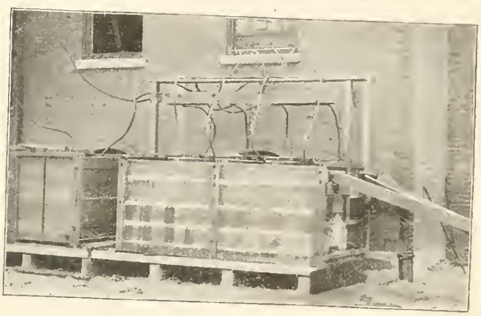


FIG. 17.—A CENTRAL STATION WATER RESISTANCE.

cate detector. The manufacturers state that it will deflect completely across the scale with an E. M. F. of .025 volts. Hence, it is necessary to use the greatest care, as the voltage from an ordinary cell is strong enough to seriously injure it. When well calibrated, it forms a good instrument for investigating leakages, strong field, etc., but unless the operator is well posted as to what he is doing it is best to let it alone.

The writer has produced sensible deflections in the instrument with a single loop of wire and a magnetized knife blade, and standing some twenty feet away from the ammeter. It forms an admirable detector for use instead of the galvanometer described in The Electrical World of February 17, 1894. It is well to shunt it with a light wire when so using it until exact judgments are obtained.

Whenever tests of any nature involving the passage of any independent current through the field coils of a machine have been made, be sure that the polarity of the machine is exactly as it was at first.

The throwing of a machine with a reverse polarity onto the bus bars is the very worst kind of a short circuit, and an armature is sure to burn out somewhere unless the fuse on the machine blows.

Short circuited field bobbins are usually cooler than their fellows. In the armature the exact reverse is the case.

For a commutator compound, the writer has heard of almost every conceivable mixture. Sperm oil gives fair results, and one man has gone so far as to recommend butter applied with a bit of bread. It has been the writer's good fortune to secure good results

with a very little vaseline, applied on a piece of felt. The rule is too little oil rather than too much, but just enough is the best. A carbon brush boiled in vaseline for a few hours will operate in a very satisfactory manner. Such a brush does not have the objectionable property of squealing.

To fit a carbon brush to a commutator, take a piece of sand paper and place it on the commutator, and tie it tightly around with a string. Then spring the brushes down on the sand paper. By means of the rocker handle oscillate the brushes back and forth, and thus grind them to an exact fit. Use different grades of sand paper, finishing with the finest. Trim off the rough edges and soak in vaseline. More trouble airses from incorrect management of brushes than from any other two causes put together. The brushes must be diametrically opposite. They must be at the proper angle. They must be in the proper position. They must have sufficient pressure to prevent sparking and jumping, but no more. Above all, both brushes and commutator should be kept scrupulously clean. At the close of a run the dynamo should at once be put in shape for the next run. It should be inspected and needed repairs or adjustments made. It should be cleaned and new oil supplied if necessary. If these rules are followed out, the station will always be ready to meet any load in the most economical way up to its maximum capacity. Copper and carbon dust is a fruitful source of trouble, which thorough cleaning will obviate.

Feel of the studs and connections; and, if these are hot, take them apart and clean and tighten them.

Do not make the common mistake of having the brushes all in line. The brushes of one holder should be staggered with regard to the next. This will insure even wear of the commutator and will avoid ruts. If the latter do come, remove them with sand paper, not emery cloth. The self-oiling bearings of a new machine must always be regarded with suspicion. Remove the oil from them every day for a week, and renew it. By that time it will be safe to consider that the loose grit has been removed. Inspect the self-oiling rings and be sure they are in motion when the dynamo is running.

A hot box on a dynamo should be treated the same as on the jack shaft or engine. Be careful about the use of ice and water, and keep them away from the armature. If absolutely necessary to shut down, do not shut completely down. Keep the dynamo turning over very slowly to prevent the boxes freezing onto the shaft. When cool, scrape the boxes and repolish the shaft.

Take the speed of the machine after starting. The governor of the engine may be out o adjustment; and, if the speed is right, any undue rise or fall of the potential of the machine cannot be attributed to this cause.

Handle the machine with one hand and stand on the wooden base frame or platform. Disagreeable shocks will thus be avoided.

A most useful adjunct to any station is a water resistance. It willf be found of great value in making tests. It is cheap and it is impossible to burn it out. Fig. 16 shows a very convenient form. By adapting the water with more or less acidulation, the capacity can be varied and to a certain extent the movable plate F will vary the resistance of the apparatus. The practical limit of carrying capacity is reached when the water boils so violently that the current becomes very unsteady.

Fig. 17 shows an actual resistance used in connection with a large central station. It is provided with sources of water supply and drains, and the resistance of the liquid can be quickly varied.

If the field circuit of a machine is suddenly opened the sudden cessation of lines of force within the coils will produce a very high pulse of electromotive force tending to keep the lines there. This force is extremely high; with a 500-volt magnet it mounts up into the thousands. It is, therefore, quite liable to puncture the insulation and is sure to take advantage of any weak spots. Hence it is very desirable to have as little current in a field circuit as possible when breaking it. In testing for short-circuited bobbins, as previously described, it is a good plan to have an incandescent lamp bridging each gap of the double pole switch. This will prevent the circuit from being completely opened, and provide a path for the discharge.

(To be continued.)

Gas vs. Electricity.

In commenting on this subject the editor of London "Lightning" writes: "I need hardly say that any comparison of costs between the two illuminants, is, to my mind, beside the question—it is quite possible that rotten potatoes cost one-tenth less than new ones."

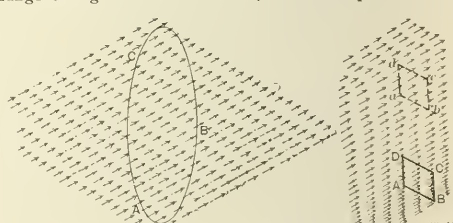
Electrodynamic Machinery—XV.

BY E. J. HOUSTON AND A. E. KENNELLY.

75. In order that the E. M. F. induced in a wire may establish a current in it, it is necessary that such wire should form a complete curcuit or loop, as indicated in Fig. 55. When such a conducting loop is moved in a magnetic field, some or all portions of the loop will cut flux, and will thereby contribute a certain E. M. F. around the loop. If the loop moves in its own plane in a uniform magnetic flux there will be no resultant E. M. F. generated in it. For example, considering a circular loop, we may compare any pair of diametrically opposite segments, when it is evident that each member of such a pair cuts through the same amount of flux per second, and will, therefore, generate the same amount of E. M. F., but in directions opposite to each other in the loop. At the same time, it is clear that the total of flux in the loop does not change; for, while the flux is being left by the loop at its receding edge, it is entering the loop at the same rate at its advancing edge, and, since these two quantities of flux are equal, the total amount of flux enclosed by the loop remains constant.

76. The cutting of flux by the edges of a moving loop, therefore, resolves itself into the more general condition of enclosing flux in a loop. The value of the E. M. F. induced around the loop does not depend upon the actual quantity of flux enclosed, but on the rate at which the enclosure is being made. If, as we have already shown, the loop is so moved that the total flux it encloses undergoes no variation, the amount entering the loop being balanced by the amount leaving it, although E. M. F.'s will be induced in these parts of the loop both where the flux is entering and where it is leaving, yet these E. M. F.'s being opposite, exactly neutralize each other and leave no resultant E. M. F. Consequently, the value of the E. M. F. induced at any moment in the loop by any motion, does not depend upon the flux density within the loop, but on the rate of change of flux enclosed.

77. If Φ be the total flux contained within a single loop, such as shown at A, B, C, in Fig. 55, the mean rate at which this flux is changing during any given period of time, will be the quotient of the change in the enclosure, divided by that amount of time, so that if Φ changes by 20,000 webers in two seconds, the mean rate of change during that time will be 10,000 webers per second, and



Figs. 55 and 56.

this will be the E. M. F. in the loop expressed in C. G. S. units. But during these two seconds of time the change may not have been progressing uniformly, and in this case only the average E. M. F. can be stated as being equal to the 10,000 C. G. S. units. Where the change is not uniform, the rate at any moment has to be determined by taking an extremely short interval, so that if dt, represents this indefinitely small interval of time and $d\Phi$ the corresponding change in the flux enclosed during that interval, the rate of change will be $\frac{d\Phi}{dt}$ webers per second and this will be the value of the induced E. M. F. at each instant.

78. If a small square loop of wire A B C D, one cm in length of edge, placed at right angles to the flux as shown in Fig. 56, contains a total quantity of flux amounting to 10,000 webers, the mean flux density at the position occupied by the square, will be 10,000 gausses. If now, the loop be moved uniformly upward in its own plane to the position *a b c d*, so as to accomplish the journey in the $\frac{1}{100}$th part of a second, and if the flux enclosed by the loop at the position *a b c d*, be 1,000 webers, then 9,000 webers will have escaped from the loop during the motion. Assuming that the distribution of flux density in the field was such that the emission took place uniformly, the E. M. F. in the loop, during the passage, will have been,

$$\frac{\Delta\Phi}{\Delta t} = \frac{9,000}{\frac{1}{100}} = 900,000 \text{ C. G. S. units} = 0.009 \text{ volt.}$$

If, however, the rate of emptying, during the motion, were not uniform, 0.009 volt would be the average E. M. F., and not the E. M. F. sustained during the interval, or, in other words, the instantaneous value of the E. M. F. in the loop would vary at different portions of this short interval of time or at corresponding different positions during the journey; but, in all cases, the time integral of the E. M. F. will be equal to the change in ϕ. Thus the change in ϕ is, in this case, 9,000 webers. When the motion is made in 1-100th of a second, the E. M. F. is 900,000 C. G. S. units of E. M. F., which, multiplied by the time, (.01 second) gives 9,000 webers. If, however, the motion were uniformly made in half a second, the E. M. F. would have been 18,000 C. G. S. units, which, multiplied by the time, would give as before 9,000 webers; and under whatever circumstances of velocity the change were made, the sum of the products of the instantaneous values of E. M. F. multiplied into the intervals of time during which they existed, would give the total change in flux of 9,000 webers. Or in symbols,

$$\text{Since} \qquad e = \frac{d\,\Phi}{d\,t}$$

$$\int e\,d\,t = \Delta\,\Phi$$

The first equation simply expresses that the E. M. F., e, is the instantaneous rate of change in the flux enclosed, and the second equation shows that the difference in the enclosure between any two conditions of the loop is the time integral of the E. M. F., which has been induced in the loop during the change.

79. If a circuit contains more than one loop, as, for example, when composed in whole or in part of a coil, the turns of which are all in series, the E. M. F. induced in any one turn or loop of the coil, may be regarded as being established independently of all the other loops, so that the total E. M. F. in the circuit will be the sum of all the separate E. M. F.'s existing at any instant in the loops, and may, therefore, be regarded as the instantaneous rate of change in the flux linked with the entire circuit. A coil, therefore, may be regarded as a device for increasing the amount of flux magnetically linked with an electric circuit, so that by increasing the number of loops of conductor in the circuit, the value of the induced E. M. F. corresponding to any change in the flux, is proportionally increased, and if the coil or system of loops forming the circuit, contains in the aggregate ϕ webers of flux linked with it, taking each turn separately and summing the enclosures, then the time integral of E. M. F. in the circuit will be the total change in ϕ, and this will be true, whether the loop is changing its position, or whether the flux is changing in intensity or direction.

(To be continued).

Practical Notes on Dynamo Calculation XVI.

BY A. E. WIENER.

PART II.—CALCULATION OF MAGNETIC FLUX.

1.—USEFUL AND TOTAL MAGNETIC FLUX.

31.—Magnetic Field. Lines of Magnetic Force. Magnetic Flux, Field Intensity.

The surrounding of a magnetic body, as far as the magnetic effects of the latter extend, is called its "Magnetic field."

According to the modern theory of magnetism, magnetic attractions and repulsions are assumed to take place along certain lines, called "Lines of Magnetic Force;" the magnetic field of a magnet, therefore, is the region traversed by the magnetic lines of force emanating from its poles.

The lines of magnetic force are assumed to pass out from the north pole and back again into the magnet at its south pole; their direction, therefore, indicates the polarity of the magnetic field.

The total number of lines of magnetic force in any magnetic field is termed its "Magnetic Flow," or "Magnetic Flux," and is measured in *webers;* a field of 1,000,000 webers, or one megaweber, for example, is one containing 1,000,000 lines of force.

The intensity of the magnetism at any point within the region of magnetic influence of a magnet, or the Field Intensity of a magnet, is expressed by the number of these magnetic lines of force per unit of field area at that point, measured perpendicularly to their direction.

The Unit of Field Intensity, is 1 line of magnetic force per square centimeter of field area, and has received the name of *gauss.*

A magnet-pole of unit strength is that which exerts unit force upon a second unit pole, placed at unit distance from the former. The lines of force of a single pole, concentrated in one point, are straight lines emanating from this point to all directions, *i. e.*, radii of a sphere. The surface of a sphere of one centimeter radius is 4π square centimeters; a pole of unit strength, therefore has a magnetic flux of 4π absolute, or C. G. S. lines of magnetic force, or 4π webers.

The number of C. G. S. lines of force, or the number of webers expressing the strength of a certain magnetic field, must consequently be divided by 4π, or by 12.5664, in order to give that same field strength in absolute units of magnetism, *i. e.*, in unit-poles.

A magnetic field of unit intensity also exists at the center of curvature of an arc of a circle whose radius is one centimeter and whose length is one centimeter, when a current of one absolute electromagnetic unit of intensity, or of 10 practical electro-magnetic units, that is, of 10 amperes, flows through this arc. Therefore, the unit of magnetic flux, *i. e.*, one C. G. S. line of force, or one weber, is equal to $\frac{10}{4\pi}$ practical electromagnetic units, or one practical electromagnetic unit $= \frac{4\pi}{10}$ webers.

32.—Useful Flux of Dynamo.

The total number of lines of force cutting the armature conductors is called the "Useful Flux" of the dynamo.

According to the definition given in Chapter 1, we have:

$$\text{Volts} = \frac{\text{Number of C.G.S. Lines cut per second}}{10^8} \quad \cdots\cdots(89)$$

Let now Φ = Total Number of useful lines, or useful flux, in webers;

K = Number of conductors all around pole-facing circumference of armature;

K = m $\times$ n, for ring-armatures;

$K = 2 \times m \times n$, for drum armatures and for drum wound ring armatures;

(where m = Number of commutator divisions,

n = Number of turns per commutator division,

$m \times n$ = Total number of convolutions of armature; See Chapter 11).

N = Speed in revolutions per minute, and

b. = Number of bifurcations of current in armature, *i. e.*, number of pairs of armature portions connected in parallel; see Chapters 26 and 27;

then,—

1 *conductor in one revolution cuts* $2\,\Phi$ *lines of force*,

for the Φ lines emanating from all the north poles, after passing the armature core, return to the south poles, hence pass twice across the air-gaps, and, in consequence, are cut twice in each revolution by every armature conductor.

The armature makes $\frac{N}{60}$ revolutions in one second, hence,

1 *conductor in* 1 *second cuts* $2\,\Phi \times \frac{N}{60}$ *lines.*

Each one of the $2\,b$ parallel armature portions contains $\frac{K}{2\,b}$ conductors connected in series; in each of these $2\,b$ armature circuits, therefore,

$\frac{K}{2\,b}$ *conductors in* 1 *second cut* $2\,\Phi \times \frac{N}{60} \times \frac{K}{2\,b}$ *lines.*

But, according to the law of the divided circuit, the E. M. F. generated in one of the parallel branches is the output voltage of the machine; the E. M. F. generated by any armature consequently, by virtue of (89) is

$$E = \frac{\Phi \times K \times N}{b \times 60 \times 10^8}\ \text{volts}, \ldots\ldots\ldots\ldots\ (90)$$

and from this we obtain the number of useful lines required to produce an E. M. F. of E volts, thus:

$$\Phi = \frac{6 \times b \times E \times 10^9}{K \times N} \quad \ldots\ldots\ldots\ldots\ldots\ (91)$$

For dynamos with but one pair of parallel circuits in the armature, *i.e.*, for bipolar machines and for multipolar dynamos with series connections, we have $b = 1$ (see b, chap. 26) and the useful flux for this special case is:

$$\Phi = \frac{6 \times E \times 10^9}{K \times N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(92)$$

This is the formula usually given in text books for the useful flux of a dynamo.

(To be continued.)

The Chinese-Japanese War.

The account of the battle of Yalu from the "Central News" correspondent cost $1,500 to cable; another telegram to the London "Times" must have cost as much.

Fly-Wheel Accidents.

BY J. J. FLATHER.

In view of the great and increasing number of fly-wheel accidents which have recently occurred, the probable causes referred to by Mr. T. C. Coykendall in your issue of October 13th, are particularly opportune.

In seeking to assign the cause for any accident which may occur we must be prepared to show: First, that the cause can exist in the case in question; second, that it is competent to produce the results ascribed to it, and third, that no other cause can produce these results under the known conditions. The history of fly-wheel accidents during the recent rise and growth of the electric railway has shown that the cause ascribed by Mr. Coykendall may exist, and with the usual construction of fly-wheels it is capable of producing rupture; but it is rarely the case that under the known conditions some other combination of circumstances can not reasonably be said to be the primary cause of the accident. This is evident from the great number of accidents in which it is an open question whether the fly wheel or driven pulley broke first.

Occasionally, however, the rupture of the wheel is directly traceable to the instantaneous hammer-like blows suggested by Mr. Coykendall, which are given to an engine when a short circuit occurs in the line and the circuit breaker is closed by the attendant while the short circuit still exists—instances of which are on record (See "Power," November, 1891, in which this condition of affairs is given as the cause of rupture in a 22-foot fly-wheel at Cincinnati). When a fly-wheel gives way the cause is usually assigned to a defective governor that allows the engine to race, in which case the centrifugal force of the mass in the rim becomes greater than its cohesive strength and the wheel bursts. That wheels do rupture from centrifugal force is indisputable, especially so where the material or method of construction is defective; spongy castings, blow holes, excessive internal strains, weak connecting flanges, bolts too small or too few in number, arms and rim too light, are all causes of weakness which have allowed wheels to go to piece with more or less disaster to life and property, when the speed was augmented somewhat above its normal rate. As an instance of this we would refer to the accident which occurred to the fly-wheel of a Corliss engine at the Charleston Cotton Mills two or three years ago.*

The wheel, which was 20 feet in diameter, had been running as about eighty revolutions per minute, and this speed was not, to alt appearances, increased at the time of the rupture. The circumferential speed was not therefore excessive for a sound wheel, but in this case one segment, which weighed about 1,800 pounds, was badly honeycombed and parted from the rim with great force. The peculiar feature of this accident was that the rest of the wheel maintained its integrity and as the engine was promptly shut down no further damage was done. A new segment was fitted into the rim and the wheel has been running satisfactorily since.

An excellent example of a fly-wheel rupturing under the influence of centrifugal force is furnished by the recent accident at Nashua, N. H., in which the wheel exploded with a violent report followed by a fusilade of shattered rim segments.†

According to "Power" the governor was unharmed and after the accident investigation showed that the pin which secured the small bevel pinion to the upright governor shaft had worked out, allowing the pinion to revolve freely upon the shaft without rotating the governor. The governor was provided with the usual safety stops to prevent the engine taking steam when the balls are away down; but this device was evidently inoperative, from the fact that the engine was running with the stop pin (provided for blocking the governor up when stopping), in position so that the governor could not fall to a plane which would bring the safety stops into action. The wheel was 30 feet in diameter and ran ordinarily at sixty-one revolutions per minute, giving a rim speed of about 5,700 feet per minute. That the wheel attained a high speed before breaking is evident. The looms, which it was driving, threw off, and the engine speeded up rapidly until the rim finally burst. The uniform manner in which it went to pieces was one of the features of the accident and showed that the wheel was well built. The rim flew into a multitude of small pieces and appears to have gone all at once. With one exception all the arms remained perfect and this one was broken near the rim. All of the complete arms retained some portion of the segment flanges, showing that the joint was well proportioned. The quality of the iron as disclosed by the fractures was good, and no indication of weakness appeared in the entire wheel.

*Power, July, '92.
†"American Machinist," Aug. 23, '94; Power, Sept. 1, '94.

That this wheel gave way by reason of excessive speed in the rim can not be questioned, but it is too often the case that centrifugal force is assigned as the primary cause of a fly-wheel accident when the evidence shows conclusively that a sudden shock to the engine was really responsible for the disaster. We have in mind a 30-ton fly-wheel in an iron mill which let go in this way. The fly-wheel was on an engine driving a train of rolls and the roller let his tongs go through the finishing rolls; the sudden shock broke the pillow block bolts and caused the rupture of the entire wheel.*

Another case, previously alluded to, is that which occurred about three years ago in which the fly-wheel of an engine in the power house of the Street Railway Company at Cincinnati, parted with disastrous results. A short circuit had occurred which threw out all the automatic circuit breakers. The switches were manipulated three times, but each time the circuit breakers opened, showing that the short circuit had not been removed. This throwing off and on of the current meant throwing off and on a load of over 700 horse power to the engine. The engineer claims that the speed was no greater than usual, but it is reasonable to suppose that whenever the circuit breakers opened, the speed was accelerated somewhat. The fly-wheel was 22 feet in diameter, and at the rated speed of the engine, sixty-five revolutions per minute, had a rim velocity of 4,500 feet per minute, which might have been exceeded very materially without causing a sound and well-designed wheel to rupture. The accident was doubtless due to the successive shocks incident to the instant application of a load far in excess of that which the engine was intended to carry, and which was thrown upon the wheel when it was presumably running at a higher speed.

As an evidence of the statement that centrifugal force and defective governors are not entirely responsible for fly-wheel accidents, we would point to the fact that heavy fly wheels have been known to go to pieces without making a revolution. Not that there is some mysterious agent at work which is liable to cause an inanimate wheel to fly in pieces at any moment,—although it is well known that wheels have ruptured while at rest,—but this particular wheel we have in mind was a large built up pulley in which the connections were inadequate even for its own weight.

Just after the engine had been started, before a revolution had been made, the lower half of the wheel dropped into the pit, while the upper half, turning sidewise, fell with a crash upon the crank and connecting rod and smashed up the engine.†

In those cases where a wheel cracks or a piece of the rim is broken out without apparent cause, the phenomenon is chargeable to the internal strains in the wheel caused by unequal contraction in the several parts while cooling, which, if it does not rupture the wheel in the mould, may cause a fracture several days afterward.

On this point Mr. Thos. D. West, a well known authority on foundry matters, states that it is practically impossible to cast wheels that will be entirely free from strains.

When a wheel of any description has cast iron arms, rim, and hub all in one piece, there is generally a strain on the arms or rim of the wheel, in extent depending on the proportion of the rim and arms. If the rim is light and the arms heavy, we may look for a cracked rim, caused by the thin rim contracting faster and to a greater extent than the arms. Again, the arms will be the part to crack if the rim be too heavy. In either instance this generally happens while the casting is yet hot and in the sand.

In the case of pulleys having the arms crack after the casting is taken out of the sand, we have a more complicated state of affairs to deal with. In pulleys having heavy arms, compared with the rim, we often see the heavy arms cracked, the light rim remaining whole. In looking at such castings it will be observed that the hub is heavy in proportion to the arms and rim. This hub is the last portion of the pulley to become solid; the rim being light, has become solid, and is already contracting, driving before it the half molten arms into the yet liquid iron in the heavy hub. When the hub solidifies, it contracts, pulling with it the arms, causing a strain, which, when the pulley gets a slight jar, will make the arms crack at the nearest point. The same principle is involved in light-armed pulleys as in heavy ones; that is, as far as the heavy hub is concerned. When there is a heavy hub required it should be cooled as soon as possible by stripping around it, taking out the core, and cooling with water.

Another method is to split the hub either between every arm or every alternate arm which thus allows a greater freedom in contracting. The hub is afterwards ringed with wrought iron or steel bands shrunk on and the openings filled with Babbitt's metal, or wooden strips.

We have alluded to the fact that in a great many cases it is diffi-

*"American Machinist," Mar. 13, '90.
†The "Engineer," 1887.

cult to decide whether the driven pulley or fly-wheel gave way first. From the evidence presented, as far as the facts can be ascertained, it is the opinion of the writer that many accidents are directly chargeable to the driven pulley. In designing pulleys and fly-wheels it is generally assumed that increasing the thickness of the rim does not add to its strength, since the centrifugal force set up in the rim (generally assumed as the cause of rupture) is directly proportional to the weight at the section. This would be true with a solid cylindrical wheel perfectly homogeneous, but since in practice such wheels are seldom employed we must consider the conditions which affect the actual problem.

It has been clearly pointed out by Prof. Unwin, Mr. Stanwood,* and others that the rim is subjected to a bending action between the arms in addition to the centrifugal stress, and should have a certain minimum thickness under varying conditions of velocity, number of arms, diameter of rim and the method of connection in split and segmental pulleys. Split pulleys with thin rims should have double arms along the line of separation since the strength of the pulley is very much reduced if the joint occur midway between two arms. Wide faced pulleys should also have two or more sets of arms that they may the better distribute the pressures and prevent lateral bending. In the same way with segmental wheels, each segment should be bolted at each end to an arm, and with wide faces two or more sets of arms should be used; otherwise a greater thickness is required. It is unquestionably true that many large receiving pulleys are too light in the rim when we consider the hard service now required of them. Even when properly proportioned and of sound iron, the initial stresses set up in the rim and arms in casting are often very great, and if the wheel is not carefully balanced for the speed at which it is to be run, its daily use with the high speeds now common will increase the internal strains so that with a slight increase of speed the danger point is soon reached, as shown in so many cases in which, from the nature of the conditions, the increase in speed could not have been what we would call excessive, showing that a very narrow margin often exists between regular speed and that necessary to burst the wheel.

With thin rims the case is aggravated. If cast so that the thickness of the rim is not uniform, or if the pulley is chucked so that the rim will have an unequal thickness after being turned, the strength to resist rupture will be proportional to its thinnest section, whereas the rupturing force is proportional to its mass. In balancing the pulley a weight is added to the thinner portion, and although the statical balance may be the same as would be produced by uniformly distributing the material over the rim, yet its centrifugal effect when the wheel is at work is concentrated at that part of the rim which is least able to bear the strain, for it is evident that an attached weight can have no effect in resisting the stress in the rim.

Both the centrifugal effect and the bending action between the arms is therefore increased in a greater proportion than the strength due to the section. A heavy rim may not require any more balancing weight than a light one, so that, in proportion to its ability to withstand it, the latter is subjected to a greater stress. Another effect tending to weaken the wheel is a want of symmetry in respect to a plane perpendicular to the shaft. This may follow from the construction or casting of the wheel itself, from the method employed in balancing, or from its being so mounted as not to run true. This feature was very ably discussed by Mr. W. Stuart Smith in The Electrical World, of December 2, 1893. Speaking of this point he says: "If a wheel is mounted so that it does not run true, that is, in such a way that the parts of the rim are forced to revolve in a continually changing plane, a strong gyroscopic action will take place, and strains be set up that are much more severe than those caused by want of symmetry alone, while a combination of the two will produce strains that are beyond the power of ordinary cast iron wheels to stand."

From the foregoing considerations it is not surprising that so many fly-wheels and pulleys have given way of late years, for although the design and construction of such wheels was never better than at the present time it is also true that more severe work is demanded of them.

The bursting of fly-wheels in electric power stations and especially in electric railway stations, where the known conditions would appear to be irreconcilable with known causes, is frequently ascribed to "those nondescript causes that swell the chapter of accidents, from which the carrying on of human affairs appears inseparable."

We have already expressed the opinion that many of these fly-wheel accidents may be due, primarily, to the rupture of the driven pulley. In seeking to assign a cause for this rupture the various elements of weakness in pulleys have been considered, and it has been shown that under suitable conditions a slight increase in stress is often sufficient to fracture the rim or arms of very wide dynamos or jack pulleys with thin rims, which may already be under severe tension due to internal strains.

*"Trans. A. S. M. E.," Vol. XIV., p. 251.

It is probable that this increase in stress is due to the effects produced by short circuiting, or an overload on the machine. Take, for instance, the case where the line is grounded.

We know that a short circuit in the line increases the load until the circuit breaker acts and relieves the engine; in case the circuit breaker fails to drop, the current is augmented and consequently the load on the machine is greatly increased until the excessive and continued sparking calls attention to the trouble and a switch is thrown if the fuse has not already been blown.

If several dynamos are run in parallel through automatic circuit breakers, and one of the latter fails to respond when a short circuit occurs, the load is thrown upon one machine, which must carry the entire current. A tremendous load is thus imposed upon the machine in either case, and under these conditions the sudden shock, often great enough to throw the belt or stall the engine, may induce sufficient strain to rupture the pulley; if the overload continues and the safety fuse is irresponsive, the slip of the belt increases and under the jerky surging motion it is perhaps thrown off; but if not, the thin pulley rim is quickly heated and the unequal expansion of the rim and arms may be sufficient, under the greatly increased strain due to the belt pull, to rupture a weak pulley, or one badly strained in casting.

An excessive overload, producing shock and heating of the thin rim, may also be responsible for the rupture of jack pulleys which are already strained by various causes close to the safety limit.

When a receiving pulley is thus broken the conditions are often favorable for the fly-wheel to follow. This may happen from various causes dependent upon a sudden shock or increased speed, or most frequently both. Thus in the Pittsburgh accident* that occurred last April in which a 20-foot by 32-inch face fly-wheel weighing 16 tons was fractured, it appears that a short circuit threw a heavy load upon the engine belt which slipped and finally broke the 5-foot jack pulley it was driving. This broken pulley presumably parted the belt, which was drawn toward the wheel with such force as to tear up the flooring and break a 1½-inch governor shaft that extended across the engine, completely stripping all the governor connections from both cylinders. The wheel thus uncontrolled may have attained an excessive speed and ruptured from centrifugal force; but the more probable explanation is that when the jack pulley broke, the belt, which usually ran at 4,700 feet per minute, may have caught and caused a severe shock upon the fly-wheel before it finally was torn apart; this sudden wrench may have been sufficient in itself to rupture the fly-wheel. The manner in which the wheel broke lends credence to the view, as each of the eight arms were fractured at about the same point near the rim, nor were any of the parts thrown to any great distance, as we should expect if the engine had raced. The Brooklyn accident which occurred at the Third Avenue Power Station in October, 1893, was probably another of the many which may be charged to a broken receiving pulley. In this case the fly-wheel was 20 feet in diameter, 52 inches face, and had a rim speed of 5,150 feet per minute. The testimony indicates that there was at first a slowing down of the engine, so great, in fact, that the engineer was afraid the governor balls would descend and cut off the steam supply, so he turned the safety cam in such a way that it would be inoperative.

(To be continued).

Fly Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir:—In the communication published in your paper on October 13th, the points to which I wished to draw attention were the following:

1. There have been a number of fly wheel accidents, in which the wheel was of good design and constructed of good material, and in which no speeding of the engine was observed.

2. The closing of the circuit breaker with a short circuit on the line would subject the engine and fly wheel to greater stress than could possibly occur from normal running conditions.

3. An engine and fly wheel, strong enough to withstand all stresses to which it might be subjected under normal running conditions, might still be destroyed by the shock due to an instantaneous load greater than the maximum for which the parts were designed.

*"Power," June, 1894.

It does not appear that due notice has been taken of the fact that destructive effects are due, not to load, but to change of load. In other words, an engine and fly wheel could be made strong enough to withstand safely a given load, and which would still be destroyed by the instantaneous application of that load.

It is assumed by most of the engineers who discuss the problem that rim stress in a fly wheel is due solely to centrifugal force, when it is well known that the bending effect of the arms on the rim gives rise to a resultant stress on the rim which is in the same direction as the resultant, on the rim sections, due to the centrifugal force This bending stress is enormously increased during change of load, owing to the increased effort of the arms and rim to change their relative positions. This, I believe, is the stress which is most dangerous to fly wheels under the conditions wihch have been discussed. Mr. Abbott appears to have realized the danger due to this cause and to have taken means to prevent it. The lamp circuit spoken of by Mr. Abbott gives undoubted information of a short circuit, but it does not go far enough, in that it gives no information when it is safe to close the circuit until the line resistance rises so high that the lamps are visibly decreased in brilliancy. In the cases of an ordinary circuit the lamps in the cars would form a circuit of sufficiently low resistance to cause the lamps in the telltale circuit at the power house to give a brilliant light when the switch was thrown in. Thus the circuit breaker may remain open long after it might be closed with safety, and delay, therefore, may be caused in the operation of the road.

From the correspondence on this subject it is evident that most engineers believe that accidents are mainly due to centrifugal force.

The opinion I desire to express here is that the sudden imposition of load gives rise to the same kind of stress as centrifugal force Therefore an accident may occur from this cause in the same way that it occurs from excessive rim speed.

Rondout, N. Y. T. C. Coykendall.

To the Editor of The Electrical World:

Sir:—The recent articles in your valuable journal from a number of contributors on fly wheel accidents have been exceedingly interesting and full of valuable suggestions. I have been particularly interested in some statements made by Prof. R. H. Thurston. If more detaching gear engines have run away and broken their fly wheels than others, it is most likely because there are more of such engines producing large power than of the non-detaching class, and he himself admits that some accidents have been due to defective fly wheel construction. The reckless use of some manufacturers' names in connection with fly wheel accidents would influence me to avoid mentioning names in an article of this kind if possible. He says that in every case that he has known, the break-down has been of machines of the detachable valve gear class. This statement indicates that he has forgotten or not heard of the accident at Memphis on the McIntosh & Seymour engine, or the one at Sioux City on the Buckeye engine, or another on the same type of engine at Cincinnati, and another which occurred at the World's Fair, Chicago, during the process of construction, on a single valve shaft governor engine, name unknown, and another on a Buckeye engine at Mobile with a throttling governor, or another on an Atlas automatic engine at Muncie, Indiana, and still another on one of the same type at Fostoria, Ohio. I am willing to concede to the manufacturers that in every instance the cause has been due to some condition or circumstance not under the manufacturers' control and for which they should not be held responsible. In the Memphis case the manufacturer clearly proved it to be due to an error in coupling up the parts of the governor, and at least one of the Buckeye accidents was known to be due to a hot eccentric yoke. The detaching valve gear engines being generally large and long stroke, necessarily have large wheels and probably run nearer the danger line than the other class, but a first class fly wheel construction prevents this from being a serious consideration.

It is well known that engineers in electric light stations and railway stations have often taken off the safety stop because of their desire to maintain a record for continuous operation with extreme loads. Probably every detaching valve gear engine in the market to-day has a device simple and effective which will shut down the engine when the governor belt breaks. The first Corliss enigne accident in this city, it is claimed, was due to tying the governor, limiting the travel of the head so that increased speed of the engine did not permit the governor to cut off the steam with the light load following a short circuit. Other cases have been known where the heating of the governor shaft has caused the shaft to stick and the b[illegible] to slip upon the pulley, causing the governor to lose speed and causing a rapid acceleration of the enigne.

Why Prof. Thurston should attempt to make a distinction in classes of valve gears for responsibility for these accidents is not clear. So long as automatic mechanism is depended upon, it must have human attention or it will fail and the opportuniites for such a failure are present equally with all types of engines. One fact may be noted, that in most of these wheel accidents the arms have not been first to break; in many cases the arms have been intact and therefore it may be assumed that load strains have not caused the accident. Chas. F. Thompson.

Cincinnati, Ohio.

To the Editor of The Electrical World:

Sir:—The discussion in your columns relative to fly wheel accidents cannot but be productive of good, for it is only by such means that the opinions of different engineers may be collected. It seems to me that, in order to secure immunity from accidents of this nature, the remedy must be such as may be applied to the Corliss engine as it exists to-day, or with very slight modification. That form of engine and valve gear as it now stands is the result of long experience and careful study. To hastily discard that style of governor would be folly. It is equally absurd to look for the speedy relegation to the scrap heap of all cast iron fly wheels. What we need for protection is a sort of "emergency stop" that will not act except in case of excessive speed, and then act wiith certainty.

The suggestion of Mr. G. H. Davis is undoubtedly good, but it is open to the objection that it is complicated, and besides this, it is only useful in electric power and lighting stations. Engine wrecks from this cause are by no means confined to such work, as we have had numerous instances of wheels bursting when driving the practically uniform load of large mills. It seems to me that, whatever the device used, it must, in order to be successful, be applicable to all conditions of load.

Having had considerable experience in the manufacture and installation of passenger and freight elevators, it naturally occurs to me that something analogous to the "governor safety" of such apparatus might be applied with advantage to the Corliss engine. In the most reliable form this consists of a governor similar in form to that of the automatic engine, but much more simple. This so-called governor, instead of controlling the speed of the car, acts only when the speed is approaching the safety limit. The revolving weights being forced outward are made to strike against and trip a stop and so allow the "safeties" to be forced to the guides by the action either of a spirng or the counterweight of the car.

In a similar device, it seems to me, we have a possible solution of the present problem. Such a governor might be placed on the shaft, as suggested by Mr. Davis, and it would then be an exceedingly easy matter to cause it to trip a weight or spring that would close an auxiliary throttle valve in case the speed became excessive.

While this may not be the best solution of the problem in hand, it has the advantages of being simple and sure to act, besides being applicable to any engine now in use.

Boston, Mass. Fred. Brainard Corey.

Signalling Through Space.

To the Editor of The Electrical World:

Sir:—Believing that your readers are always interested in electrical phenomena, and having noticed from time to time articles bearing upon the subject of "signalling through space," the writer begs to submit the following data concerning an interesting and somewhat exceptional case of telephonic induction.

A trunk line of telegraph wires passes through Mechanicsburg, Pa., from Harrisburg, Pa., to Pittsburg, the distance between the first two stations being eight miles. A short telephone line with earth return runs from Mechanicsburg to a small station about a mile west, parallel to the above trunk line and about 100 feet from it. One calm Sunday afternoon the writer had occasion to transmit two messages over the telegraph line to Harrisburg, whence they were to be sent to Baltimore. After sending both, I casually placed the telephone receiver to my ear and could plainly hear the ticking of telegraphic instruments in the Harrisburg office. To my surprise, I soon heard the Harrisburg operator sending my messages to Baltimore. In this connection it is to be remembered that the Harrisburg—Baltimore line runs due south while the first named trunk line runs due west. The two lines, however, terminate in the same switchboard at Harrisburg. Induction probably takes place from one telegraph line to another and then eight miles away the induced current on the telegraph line influences the short telephone line. E. A. Grissinger.

Pittsburgh, Pa.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS
BY CARL HERING

ELECTRO-PHYSICS.

Propagation of Waves in Ice.—A French Academy paper from "Comptes Rendus," vol. 119, No. 15, by Mr. Blondlot "On the Propagation of Electromagnetic Waves in Ice, and on the Dielectric Power of this Substance," is translated in the Lond. "Elec.," Oct. 19. In a previous paper he enunciated the theorem that the length of the waves is the same whatever the insulating medium, and that it depends only on the dimensions of the oscillator; in the present paper he describes experiments conducted with ice and finds that the theorem is as true for ice as for other dielectrics, and that consequently Maxwell's relation according to which the specific inductive capacity is equal to the square of the index refraction, is true for electro-magnetic undulations through ice. From the experiments he finds that the dielectric power of ice is about 2.

Origin of Earth Currents.—Mr. Bachmetjew's paper (see Digest, Oct. 27) is concluded in the "Zeit. feur Elek.," Oct. 15. He discusses the question of how earth currents are produced and describes some tests made with wires on a plane near Sophia; he gives a summary of the opinions of others on this subject, from which he concludes that the cause of such currents must be looked for in the earth or in its atmosphere; he then states that they cannot be caused by the atmosphere and concludes from his experiments that earth currents are produced partially by thermo-electric effects, and partially by electromotive forces generated by the filtration of water through the soil; in certain researches from which he quotes, the E. M. F. generated by pure water filtered through sand in a clear atmosphere, is equal to 6.825 volts.

Earth Currents.—"L'Eclairage Elec.," Oct. 6, contains a paper by Mr. Palmieri, describing experiments with earth currents made with a wire from the foot of Mt. Vesuvius part way to its apex; the experiments are to be extended to find the connection between the earth currents and an eruption.

Atmospheric Electricity.—According to the Lond. "Elec. Rev.," Oct. 19, Mr. Franklin Fox calls attention to the fact that Saxby claimed electricity to be the cause of all weather; what is wanted is a gauge of the electricity in the air, which could be attached to barometers, which would afford a check on the supposed effects of electricity and which would enable a barometric reading to be made with more insight into its action.

MAGNETISM.

Constant-Pull Electromagnet.—A device by Messrs. Schoeller & Jahr, is described and illustrated in the "Zeit. feur Elek.," Oct. 15. It consists essentially of two magnets, one of which is of the ordinary **U** type and is pivoted at its neutral point so that its poles move past those of the other magnet which has three poles and cores, the middle pole being of one polarity and the two outside ones of the other, being equivalent to two **U** shaped magnets with a like pole of each combined to form one pole; the movable magnet is pivoted so as to be capable of moving from a position nearly opposite two of the poles to a position nearly opposite the two others, thus describing a small arc of a circle; it is claimed that the attraction to one side increases at the same rate as the repulsion from the other side diminishes; the commutator enables the current to be reversed in one of the magnets to produce the reverse motion.

Steel.—A few values for the magnetic qualities of an exceedingly good dynamo steel made by an English firm, are published in "Ind. & Iron," Oct. 19.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Simple Electrical Method for Testing Dynamos and Motors.—In the Digest, Sept. 8, a method devised by Mr. Lenz was described; in the "Zeit. feur Elek.," Oct. 15, Mr. Grau criticises this method; from this criticism the description of this method becomes more clear and as the previous description was very indistinct, besides containing apparently some typographical errors, it is thought best to give a brief summary of the description as it now appears, in order that the discussion may be more clearly understood. The motor is run unloaded at the required speed and is found to consume M watts; it is then coupled mechanically with any convenient dynamo, which is separately excited with a constant current whose value need not be known, the dynamo being run without a load; from the power then required by the motor deduct M, leaving D, the power used in the motor to run the dynamo unloaded; M and D may be assumed to be constant; the dynamo is then loaded and delivers at constant speed W watts, including the resistance loss in the armature; the power then consumed by the motor (after subtracting M and D) corresponding to this power W, is then calculated and represented by Z; this latter test is repeated for any desired number of different loads on the dynamo, from full load to nearly no load; if the quotients of $W \div Z$ for the different tests are made ordinates of a curve and the sums of $M + Z + D$ are made the abscisses, it will be found that the curve will be nearly a straight line, especially for small loads; the ordinate for no load on the dynamo may therefore be taken as equal to the quotient of $W \div Z$ for the smallest load, which value of this quotient is represented by E; the electrical equivalent of the mechanical power delivered by the motor to the dynamo in the second test (when the dynamo was not loaded) therefore becomes known (as D multiplied by this value of the quotient is this electrical equivalent); the power delivered by the motor for each load on the dynamo will then be $D+E+W$, while that consumed by the motor will be $M+D+Z$, all the quantities being in watts; the efficiency of the motor will then be equal to the former divided by the latter.

In the discussion Mr. Grau claims that there are a number of errors in this method; Mr. Lenz claimed that the Cardew method is based on the incorrect assumption that the efficiency of the machines is the same when used as a generator and when used as a motor; Mr. Grau states that it is well known that the Cardew method is completely independent of this assumption, for if each of the three machines is used once as a motor and then as a generator, the solution of the six equations gives an absolutely correct and reliable result. He states that in Mr. Lenz' method the value of M is assumed as constant, but this he claims is incorrect, as it will change with the load on the motor owing to the short-circuiting of the coils by the brushes, also on account of the reaction of the armature current on the field. The values of the quotients $W \div Z$ are not correct, as they include the factor of the short circuiting of the armature coils by the brushes, the value of E is therefore only approximate. The formula for the efficiency contains the value D, which is assumed to be constant, but this, he claims, is not correct, as its value would be a different one when the dynamo is loaded on account of the armature reaction; as these three values which are assumed as being constant, are not so, he believes that this method will not be much more accurate than the dynamometric method, but in all cases much less accurate than the Cardew method. In replying to this Mr. Lenz states that when he spoke of there being no load, he meant it literally and that for no load the value of M is a constant; he claims that in his method the changes in the loss in the motor due to increasing loads, are taken into account, as the curve includes these changes; regarding the value of E, he states that the error due to the short circuiting of the coils amounts to only 0.4 per cent. of the total, which may introduce a small error, which, however, is still further reduced by another correction; the value of E may be determined as accurately as one desires by diminishing the current of the dynamo, but as the curve at small load is so nearly parallel the accuracy of the value of E is quite great. Regarding the value of D in the efficiency formula, he replies that its value applies only to no load; the effect of the hysteresis loss is about 1.5 per cent. of that at full load; and the reaction of the armature winding is about 5 per cent. of the action of the field; the hysteresis loss increases more rapidly than the magnetic density and one can assume that the hysteresis loss is diminished by 5 per cent., but even an assumption of 50 per cent. would not be worth considering; the error is diminished by that due to the short circuiting of the coils, so that the mean total error of 0.3 per cent. may occur; a method which is correct to 0.3 per cent. may well be termed a correct and not an incorrect one. (For another method see an abstract under "Dynamos and Motors.")

Localizing a Fault.—In the Lond. "Elec. Rev.," Oct. 12, Messrs. Jordan & Schoenau describe a modification of Anderson & Kennelly's method; in the original method a variable resistance is inserted at the end nearest the fault and is varied until the resistances measured from both stations are the same; this involves time and a necessity of speaking between each set of readings, which tends to polarize the fault; to overcome these objections they insert a variable resistance at each of the two ends of the cable, each operator earths alternately for the other, while the other adjusts the resistance so that the total remains the same. They show that the value of the total resistance at which it will be most advisable to commence balancing, is equal to the sum of the resistances measured from each station when the distant end is earthed; this "earth overlap" test can be applied with equal advantage to the "insulation overlap" test.

Board of Trade Laboratory.—The article in the Lond. "Elec. Rev.," Oct. 12, is continued in the issue of Oct. 19; the ground plan of the

laboratory and the current and pressure standards, already mentioned before in the Digest, are described and illustrated.

Magnetic Testing Machine.—The apparatus described in the Digest, Aug. 18 (see also Sept. 15), is described and illustrated in the Lond. "Elec.," Oct. 19.

Testing Set.—A brief illustrated description of the Turvey set, consisting of a resistance box and galvanometer, is published in the Lond. "Elec. Eng.," Oct. 19.

DYNAMOS AND MOTORS.

Calculating the Current for Continuous Current Motors.—In the "Elek. Zeit.," Oct. 18, Mr. Mueller states that as the determination of the efficiency of a motor by means of a Prony brake requires considerable time and is rather expensive for large motors, he proposes the following indirect method to determine the mechanical output of a motor. Let the motor be run unloaded and the voltage be regulated so that it will run at its required speed, then measure the voltage and current; from the product deduct the resistance loss in the armature and the result will be the power required for running unloaded, representing the hysteresis and Foucault current losses, the bearing and air friction; the horse power delivered, at any desired load, is then equal to the watts delivered to the motor, less the resistance loss in the armature, less the above mentioned quantity, and the whole divided by 746; from the equation thus formed he deduces (from the quadratic equation) the value of the current and finds it equal to the following:

$$C = \frac{e - \sqrt{e^2 - 4\,R\,(\text{hp} \times 746 + W)}}{2\,R}$$

in which e is the voltage at the terminals of the motor, R the resistance of the armature with brushes and connections, and W the power at no load above referred to. This formula is for shunt motors; if it is a series motor the combined resistance of the field and armature must be substituted for the armature resistance; the use of the formula is illustrated by an example. Experiments have shown that by this method more reliable results can be obtained than by the use of the Prony brake and it requires only a single person to make the test, while the other requires three persons. In an editorial discussion it is stated that this method for determining the efficiency, which is also applicable to generators, has the advantage that it is a rapid method and can be carried out at but slight expense; it has frequently been used by others but may not be generally known; it is, however, not as accurate as might be desired; the assumption that the hysteresis and Foucault losses are the same when loaded as when unloaded, is not correct, for in general both losses will increase with the load, especially the Foucault current losses; it should also be noticed whether the armature is a ring or a drum, as in the former the increase of these losses is greater; another reason why it is inaccurate in machines driven by belts lies in the fact that the bearing friction will increase with the tension on the belt, so that the efficiency according to this method will be higher than the true result, but in all cases where great accuracy is not necessary, this method can be used to advantage. (For another method for determining the efficiency see an abstract under "Measurements.")

Alternate Current Motors.—A patent of Hutin & Leblanc for the production and maintenance of synchronism is described and illustrated in the "Elek. Anz.," Oct. 14.

ARC AND INCANDESCENT LIGHTS.

Holophane Globes.—"L'Ind. Elec.," Oct. 10, contains a description at some length, by Mr. Claude, of the diffusing globe called "holophane" invented by Messrs. Blondel & Psaroudaki. This is said to be a truly scientific solution of the problem of proper diffusion of the arc or other light, the results being quite remarkable; the object is to diffuse the light by total reflection and refraction in a globe of perfectly transparent glass; these globes are made with vertical corrugations on the inside surface and horizontal corrugations on the outside surface and are formed of pressed glass; —the interior corrugations diffuse the light horizontally and the exterior ones diffuse it vertically. The theory is discussed at some length and it is shown that the corrugations must be determined very carefully in order to avoid the internal reflection from the glass, most of which would represent a loss similar to the absorption of an opal globe; for interior lighting, where a general diffusion is required, the corrugations are all similar, but for street lighting they are so proportioned that all points on a horizontal plane below the globe, are uniformly illuminated up to an inclination of 15° below the horizon (in this connection attention is called to the curve shown in the Digest, Aug. 11); this is caused partially by a total reflection of the rays which originally pass above the horizon of the lamp; such a globe appears from a distance like a ball of uniform brightness all over. The results were confirmed by some tests with a globe 15 in. in diameter around an arc lamp, the curves of illumination of which, with and without the globe, are given; the former is such that the light on the horizontal plane below the lamp is nearly uniform for a radius equal to about three times the height of the lamp; the absorption was [illegible] found to be 13 per cent. and in another, 9 per cent., which corresponds to about the absorption in transparent glass, showing that the diffusion is obtained without loss; in addition to this there is a slight irridescence to the light which gives it a peculiarly rich appearance; he believes this solves the problem of interior illumination with arc lights.

Projectors.—The first part of a long serial by Messrs. Tchikoleff & Turin is concluded in "L'Eclairage Elec.," Oct. 6; it treats of the relative visibility of the illuminated objects. The second part of this treatise will be published in the near future.

Diminishing the Consumption of Arc Light Carbons.—A translated description of the device of Mr. Jehl, abstracted in the Digest last week, is published in the Lond. "Elec.," Oct. 19, with the illustration.

Filaments.—According to "L'Eclairage Elec.," Oct. 6, Mr. Baum increases the refractory power of the filaments by treating the organic fibres with phosphate of ammonia, chlorohydrate of ammonia, chlorate of calcium and chlorate of magnesia; they are then exposed to a high temperature to volatilize the ammonia salts, forming a porous phosphate of calcium and magnesia; they are then treated with a dilute solution of gelatine and carbonate of calcium.

Telescopic Suspension.—An arrangement for chandeliers and suspended electric lights, is described and illustrated in the "Elek. Tech.," Oct. 15.

ELECTRIC RAILWAYS.

Working Expenses of Railways.—The article begun in the Lond. "Elec. Rev.," Sept. 7 (see Digest, Sept. 29), is continued in the issue of Oct. 19. Similar tables are given for the Birmingham and Edinburgh cable lines, the only two in Great Britain for which the data is available. In conclusion it is stated that from the figures given it appears that electric traction for short local lines, where the traffic is sufficient, can compete favorably with steam locomotives, "while in the case of street tramways it will be difficult to find any method of haulage which, with a fair traffic can be operated more economically than the cable system."

High Speed and Power of Locomotives.—The paper from the French by du Bousquet, mentioned several times before in the Digest, is abstracted in the "Foreign Abstracts" of the Institution of Civil Engineers, vol. 118, part 4, in which the tables of results are given; they include the resistance per train ton for various speeds and grades, also the power required to move one ton at different speeds and grades; another table gives the weight of locomotive for a number of different speeds (although referring to steam locomotives some of the results are applicable also to electrical high speed traction).

Mechanical Traction for Street Railways.—The translation of the paper by Mr. Marchena, mentioned in the Digest, Oct. 6, is continued in the Lond. "Elec.," Oct. 19; some tabulated data is given for the efficiency of three motors variously connected for different grades and speeds.

Underground Conduit Road.—An improvement recently made in Europe, of the Love conduit system, is briefly but very indistinctly described in the "Elek. Tech.," Oct. 15; it is said to have been tried and to have shown itself to be a very important improvement.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Phase Regulation.—In a communication to the "Elek. Zeit.," Oct. 18, Mr. Arnold, in referring to the suggestion of Mr. Imhoff (see Digest, Oct. 13) to use the exciter as a phase regulator, states that this idea would not be applicable in any case; with a simple calculation he shows that the capacity of the exciter in cases in which phase regulation is necessary, will be far below the required capacity; he calculates the results for a case in which the phase difference is 45°, in which case the capacity of the extra dynamo (which is connected in parallel with the generator) to generate the wattless current, will be equal to that of the generator; for smaller values of the angle of lag than that for which the cosine is equal to 0.95, phase regulation will hardly be necessary, but even in this case the capacity of the extra generator would still be 32.6 per cent. of that of the main generator, from which it is seen that the capacity of the exciter is far too small; he also intimates that there are other reasons why such an application of the exciter in installations would not be practicable. He shows the importance of the use of an extra generator in that it has a favorable effect on the proportioning of the main generator; by calculation he demonstrates that if such an extra generator is used, the main generator can be proportioned considerably smaller; it is not necessary, however, that the shifting of the phase in the generator need be neutralized entirely, as it is sufficient in many cases that the extra dynamo supplies only a part of the magnetization current; this is the case in the installation mentioned in the Digest, Oct. 27; in conclusion he states that the phase indicators of Dobrowolsky are very useful instruments for the regulation of the phase difference.

Three-wire System.—In the recently published article by Mr. Claude, abstracted in the Digest, June 23 and July 7, he recommends replacing the three-wire system by a two-wire system in which two lamps are always connected in series. A further discussion of the system is contained in "L'Eclairage Elec.," Oct. 6, and translated in the Lond. "Elec. Eng.," Oct. 19. Mr. Vitte approves of the system, which appears to be in use in a station in Lyons and recommends that in the exceptional case where only one lamp is to be used, lamps of 200 volts could be employed or else two lamps of half the candle-power can be placed in series; he thinks the system has very great advantages. One

of the advantages stated by Mr. Claude is that it enables the lamps to be forced to 2.5 watts per candle.

Melbourne.—A description of the central station is published in "Ind. & Iron.," Oct. 19.

Electrical Speed Indicator.—The Spratt indicator is illustrated and described in detail in the Lond. "Elec. Rev." Oct. 19; an electrical circuit is closed periodically through a brush and a segment on the shaft, and this operates a somewhat complicated mechanism on the indicator; the indicator contains a button which must be pressed for exactly fifteen seconds, during which time the number of contacts made, reduced to revolutions per minute, will appear in figures on an annunciator dial.

Lightning Arresters.—In an article of some length begun in the "Elek Echo.," Oct. 20, Dr. Denzler gives a descriptive summary of lightning arresters for lighting and power circuit, accompanied by diagrams.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Subscribers' Telephones without Batteries—The Merino system in which the batteries are at the central station instead of at the subscriber's end, described in the Digest, Aug. 4, is described with illustrations in "L'Eclairage. Elec.," Oct. 6.

Induction in Telephone Circuits.—A recent paper by Mr Muench, of the German Telegraph Department, is reprinted in part in the "Zeit. feur Elek.," Oct. 15.

Minimum Current in a Telephone.—Lord Rayleigh's paper, abstracted in the Digest, Oct. 6, is published in part in the Lond. "Elec.," Oct. 19.

Telegraph Statistics.—According to the Lond. "Elec.," Oct. 19, the total number of telegrams transmitted in the United Kingdom in 1892 was about 70,000,000; in the United States 62,000,000; in France 32,000,000; in Germany 31,000,000; in Austria 11,000,000 and in Italy 8,000,000.

Bells with Different Sounds.—A device by Mr. Neuman is described in the "Elek. Tech.," Oct. 15; the single bell is replaced by two concentric bells of different musical notes, each having its own clapper, thus enabling two different signals to be given, while a third different signal is produced by pressing both buttons and ringing both bells together.

Clocks.—The apparatus for clocks driven by an alternating current is illustrated and described in the "Elek. Anz.," Oct. 18.

ELECTRO-CHEMISTRY.

Electric Energy from Combustion of Coal.—An editorial in the "Elek. Zeit.," Oct. 11, reviews a recent paper by Dr. Borchers, a full report of which is promised in the next issue. He gives the results of experiments for transforming the chemical energy into electrical energy by the oxidation of combustible material; although conducted on a small scale they show that it is quite possible to do this; currents up to ½ ampere were obtained by the combustion of carbonous oxide into carbonic oxide, the two electrodes, copper and carbon, not being consumed; in another test, fine coal dust was used instead of gas, but it has the disadvantage that the electrolyte must be changed frequently on account of impurities; when Dowson, or a similar gas, was used, the action appears to have been increased.

Accumulator Bolt—A bolt is described and illustrated in "Cosmos," Oct. 20, in which the nuts are formed of caps completely covering the ends of the bolt with the intention of completely covering the thread so as to protect it from the action of the acid.

Chemical Theory of Accumulators.—Mr. Wade's article is continued in the Lond. "Elec.," Oct. 19; he discusses the more purely chemical aspect of the discharge phenomenon.

MISCELLANEOUS.

Application of Motors.—The article mentioned in the Digest. Oct. 27, is continued in the Lond. "Elec Rev.," Oct. 12. Several motors are described and illustrated; an illustrated description is given of the Baynes automatic starter for motors, in which an acid resistance and a damper are used and in which 30 seconds are required to put the full power on the motor; wherever sudden loads are thrown on the motor he insists upon using fly-wheels on the motors; the application of electricity in mines is also discussed; among the results of the tests it is stated that with a 42-inch band saw with 4 ft. per minute feed, the cost of cutting oak was .3 cents per foot (presumably for the current only); the cost of cutting deal with a 30-inch circular saw and a feed of 13.3 ft. per second, the peripheral speed of the saw being 10,895 ft. per minute, was 0.18 cts. per foot; an elevator running at 80 ft. per minute with a full load of one ton costs one cent per trip at 12 cts. per kilowatt-hour; a chopping machine cost 0 4 cts. per pound of meat when chopping 110 pounds.

Launches.—An illustrated description of several recently constructed launches is given in the "Elek. Anz.," Oct. 14.

Coal Cutting Machines.—In the conclusion of the long serial by Mr. Snell on "Electric Motive Power" in the Lond. "Elec." Oct. 19, he describes and illustrates some coal cutting machines.

Submarine Detector.—The M'Evoy detector is described in several of the London journals for Oct. 19. A description was published in the Electrical World last week.

Concentration of Sulphuric Acid.—An abstract from an article in the "Chemiker Zeitung," is published in "L'Elec.," Oct. 6; it states that 32,671 calories, corresponding to 51.3-hp hours, or with radiation to 60-hp hours, are required to concentrate 117-kg at 60° concentration to 100-kg at 66°; whether it would be cheaper to do this by electricity depends on the cost of the current.

Dermatines.—A description of this material is given in the "Elek. Tech.," Oct. 15; it is a material belonging to the same class as India rubber, but is prepared differently, carbonate of magnesia being used "for compensating the sulphur for vulcanization;" it is said that it resists all atmospheric influence and does not become brittle with time, as is the case with India rubber, in which the acid produced by the sulphur is not neutralized; the material is not vulcanized, but is aged by a different process; in dissolving, no materials like benzine, naphtha, etc., are used, which, in the ordinary rubber involves a subsequent oxidation process; the process is that of Mr. Zingler in England.

Extraction of Teeth.—According to "La Nature," Oct. 13, a London dentist extracts teeth by connecting the two hands of the patient with the poles of a Ruhmkorff coil having a very fine wire secondary and an interrupter making 452 vibrations a second; the current is increased to as much as the patient can stand and the extracting tongs are then "put into circuit" and placed on the tooth, which, "under the action of the vibrations," is easily extracted; no other sensation is said to be experienced than that of the current.

Municipal Central Stations.—An editorial in the "Elek. Zeit.," Oct. 18, criticises a recent statement in a German paper to the effect that from a commercial standpoint municipal stations are not to be recommended; the editorial claims that had the deductions been made from German stations the results would have been different; as it is, they were based largely on English and American stations, in which the conditions are quite different from those in the average German station; from a table of data published in the same number, giving the net profit and the interest which it represents, it appears that these well designed and well conducted German stations not only give satisfactory results from an engineering standpoint, but also from a commercial one. The same article is also discussed at some length in the "Elek. Anz.," Oct. 18.

Educational.—A description of the course and the laboratory of the school at Chemnitz is given in some detail in the "Elek. Echo," Oct. 20.

Biographical.—The "Elek. Zeit.," Oct. 18, publishes a recent paper by Dr. Ostwald on "Johann Wilhelm Ritter, the Founder of Scientific Electro-Chemistry;" his researches were made almost a century ago.

Abstracts.—The "Foreign Abstracts" of the Institution of Civil Engineers, vol. 118, part 4, contains a large number of abstracts of recent electrical papers; with the exception of those appearing originally in American papers, they have all been abstracted in the Digest, though not to such length as they appear in that publication.

Moonlight Tables for December, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of December under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	7.10 P. M.	2	6.10 A. M.	1	5.00 P. M.	2	6.10 A. M.
2	8.20 "	3	6.10 "	2	5.00 "	3	6.10 "
3	9.20 "	4	6.10 "	3	5.00 "	4	6.10 "
4	10.20 "	5	6.10 "	4	5.00 "	5	6.10 "
5	11.20 "	6	6.10 "	5	5.00 "	6	6.10 "
6				6	5.00 "	7	6.10 "
7	12.20 A. M.	7	6.10 A. M.	7	5.00 "	7	12.00 M.
8	1.30 "	8	6.10 "	8	1.30 A. M.	8	6.10 A.M.
9	2.30 "	9	6.10 "	8	5.00 P. M.	8	12.00 M.
10	3.40 "	10	6.10 "	9	5.00 "	9	"
11	No light.	11	No light.	10	5.00 "	10	"
12	"	12	"	11	5.00 "	11	"
13	5.00 P. M.	13	6.20 P. M.	12	5.00 "	12	"
14	5.00 "	14	7.40 "	13	5.00 "	13	"
15	5.00 "	15	9.00 "	14	5.00 "	14	"
16	5.00 "	16	10.10 "	15	5.00 "	15	"
17	5.00 "	17	11.30 "	16	5.00 "	16	"
18	5.00 "	19	12.40 A. M.	17	5.00 "	17	"
19	5.00 "	20	1.50 "	18	5.00 "	19	12.40 A.M.
20	5.10 "	21	2.50 "	19	5.00 "	20	1.50 "
21	5.10 "	22	4.00 "	20	5.00 "	21	2.50 "
22	5.10 "	23	5.10 "	21	5.10 "	22	4.00 "
23	5.10 "	24	6.20 "	22	5.10 "	23	5.10 "
24	5.10 "	25	6.20 "	23	5.10 "	24	6.20 "
25	5.10 "	26	6.20 "	24	5.10 "	25	6.20 "
26	5.10 "	27	6.20 "	25	5.10 "	26	6.20 "
27	5.10 "	28	6.20 "	26	5.10 "	27	6.20 "
28	5.10 "	29	6.20 "	27	5.10 "	28	6.20 "
29	5.10 "	30	6.20 "	28	5.10 "	29	6.20 "
30	5.10 "	31	6.20 "	29	5.10 "	30	6.20 "
31	8.10 "	1	6.20 "	30	5.10 "	31	6.20 "
				31	5.10 "	1	6.20 "

Total No. of hours, 245.10.

NOTE.—These schedules are made up on sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

New Books.

CENTRAL STATION BOOKING AND SUGGESTED FORMS. With an Appendix for Street Railways. By Horatio A. Foster. New York: The W. J. Johnston Co., Ltd. Cloth. 140 pages. Price, $2.50.

Mr. Foster rendered substantial aid to the electrical industry when he published about three years ago a little book of fifty pages on "Central Station Management and Finance." Since the issue of the former book, Mr. Foster has critically examined, as agent of the United States Census, a large number of electrical stations, and as a result of that experience and further study he offers the present treatise as an improvement upon and extension of his earlier work.

The book contains a classification and analysis of the various accounts that are likely to be required in the business management of an electric light or power station. In addition to this system of bookkeeping, which constitutes Part I, Part II is devoted to a number of suggested forms for reports of engineers, inspectors, linemen and other employés, requisitions, orders and similar blanks.

The book thus contains a very complete and systematic scheme of accounting and general management, which, as stated by its author, need not be adopted bodily, but will serve as a basis and may be modified to suit any particular case. In fact, no one organization is ever likely to require all the accounts, reports, etc., that are given, but the officers of each company can readily leave out or combine accounts or blanks, according to circumstances. The various accounts are arranged in five general classes, viz.: Operating expenses, income, profit and loss, property and resources and liabilities. The first class, operating expense, is divided into three parts, manufacturing, distribution and general expense, and each of these comprises seven or eight items, such as repairs, labor, fuel, etc. It is to the operating expenses that particular attention is given for the reason that these accounts are most important in guiding and improving the management and economy of a station. Nevertheless, these very accounts are usually kept less accurately and less intelligibly than any of the others, and it is rare to find a station in which the costs of production are definitely known. The numerous losses and leaks that may exist in the operating expenses necessitates a very careful sub-division and scrutiny of these accounts in order that any fault may be promptly detected and rectified.

Mr. Foster points out that in larger stations an immense amount of writing and danger of error may be avoided by adopting the voucher system instead of keeping a ledger account with each individual creditor. This applies to small accounts, but if many purchases are made during a month, or there is trading back and forth, it would then be more convenient to keep a special account in the usual way.

In the voucher system all invoices, after approval for quantity, prices, etc., by the proper authorities, are credited to an account called "Audited Vouchers," which may include many small creditors and thus greatly reduce the number of ledger accounts. There is little to find fault with in the text or making of the book, except that a number of sample headings for ledgers, registers, etc., are folded into it, and since they are full size, they are in many cases very clumsy. For example, Form No. 56, for "Meter Customer's Register," adds fourteen thicknesses of paper to the bulk of the book, which might easily be reduced to five if the last ten months of the year were omitted, they being precisely similar to January and February, and might safely be left to the reader's imagination. This difficulty is trifling, however, and can easily be overcome by cutting out the superfluous paper.

The book as a whole is clear and thorough, and should be gratefully received by electrical engineers and business men.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY. Fifth Year of Publication. The W. J. Johnston Company, Ltd. 760 pages. Price, $5.00.

While it is, of course, well-known that the capital invested in the electrical industry is enormous, and that central station lighting, electric street railway traction, isolated incandescent lighting and the supply business connected with these have taken on huge proportions, yet it is doubtful if the actual extent they have reached is fully realized. These facts, however, are very forcibly presented by a glance through the pages of Johnston's Electrical and Street Railway Directory, the 1894 edition of which has just appeared from the press.

That an industry which came into existence but little over a decade ago should now require a directory of no less than 741 octavo pages furnishes in itself a significant indication of unparalleled growth, which is accented when we come to consider the numerical side of the subject.

In the arrangement twelve departments or divisions have been made, as follows: Central Stations: Prices Paid for City Lighting; Isolated Electric Plants; Electric Mining Plants; Street Railways; Telephone Companies; Telegraph Companies; District Messenger Companies; Electrical Associations, Societies, etc.; General Electrical Trades, arranged both geographically and by trades and, finally, in an Alphabetical Finding List.

Under the first of these heads—Central Electric Light Stations—we find enumerated 2,344 different plants in the United States, Canada, Mexico and Cuba, with an aggregate paid in capital stock of $277,437,-113 [illegible] e plants being distributed as follows: United States, 12,124; Canada, 172; Mexico, 41; Cuba, 7.

The 965 street railways enumerated aggregate the enormous sum of $648,330,755 capital invested. This sum is divided among the various systems as follows: 606 electric railways, $423,493,219; 359 horse, steam and cable railways, $224,837,536. The remarkable growth in electric railways is indicated by the fact that in 1889 there were only 200 miles of such road, which, in 1891, had increased to 2,250 miles, and in three years more to 7,470 miles.

Information relating to about 7,500 isolated electric light and 275 mining plants is given in their respective departments, and in another have been collected the prices paid for city lighting, which are given for 353 cities and towns in the United States and Canada.

The names and addresses of 5,444 manufacturers, dealers, electricians, etc., are arranged in three lists—in one geographically according to cities and towns, in another according to lines of business and alphabetically in a third or finding list.

It is interesting to note the distribution of manufacturing and commercial firms connected with the electrical industries; New York, Pennsylvania, and Massachusetts lead with 1,219, 682 and 627 firms respectively; next in order are Illinois with 535, Ohio with 355, and New Jersey with 218; the other states having more than 100, but less than 200 firms, are Connecticut, Michigan, Missouri, California and Indiana.

A feature that will be appreciated by electrical supply and other dealers is the information given in regard to the size of plants, type of lamps, cars and other apparatus used, and the names of managing officials and purchasing agents.

ELECTRICITY, ELECTROMETER, MAGNETISM, AND ELECTROLYSIS. By G. Chrystal, M. A., LL. D., and W. N. Shaw, M. A., F. R. S., Reprinted from the ninth edition of the Encyclopædia Britannica, 1894. New York: Macmillan & Co.: London: Adam and Charles Black. 180 folio pages, illustrated. Price, $1.60.

The book, being as stated, a reprint of articles from the Encyclopædia Britannica, the original numbering of the pages is followed and does not always correspond with the actual pages of the present volume. The articles on electricity, electrometer and magnetism, are by Prof. Chrystal, and the article on electrolysis is by Prof. Shaw. Besides these there is a short article by F. W. Rudler, on electro-metallurgy, which is not mentioned on the title page. The Encyclopædia Britannica being so widely known, it is almost superfluous to review *in extenso* these reprinted articles. For the benefit of those who are not acquainted with the original, however, we will refer to them briefly.

The articles on electricity and magnetism, taken together form a short treatise, from which a very good general knowledge of these sciences may be obtained. The mode of treatment of the subjects may be characterized as an abridgement of Maxwell's work. That is, the mathematics are the same, only not carried so far, which makes it somewhat easier reading. It must not be inferred, however, that these articles are a mere epitome or synopsis of Maxwell's work, for the reading matter in itself is entitled to rank as an original treatise.

The article on electricity opens with the usual statements regarding the derivation of the word electricity from ἤλεκτρον-amber, and the observations of Thales in the year, 600 B. C., which were so thoroughly thrashed out in the columns of this journal a year and a half ago.

The original articles having been written a number of years ago, and not having been in any way revised in this reprint, may not be strictly up to date, but otherwise are most excellent and worthy of the honor which has been done them by publication in a separate book.

The article on electrolysis is for its length (eight and one-half pages) probably the best work on the subject in the English language. It is a purely theoretical article, as it should be; the practical applications belonging under other headings, such as electro-metallurgy, electroplating, etc. The article on electro-metallurgy, however, is rather unsatisfactory, and refers the reader who wants to know more to a number of other books on the subject. As, however, this article is thrown in gratis, and not even mentioned on the title page, any criticism of it does not apply to the present book, but to the Encyclopædia Britannica. Moreover, the article itself states that the cause of its limitation is the want of space.

The work in its present form is a very convenient size to handle, and more easily referred to than the encyclopædia volumes, so that it may be advantageous to electricians who already have the encyclopædia, but those who do not possess the encyclopædia, will certainly find it a valuable addition to their libraries.

A New Insulation.

One of the most serious questions that confronts the builders and operators of dynamos and motors is how to prolong the life of such apparatus.

To eliminate the element of uncertainty that exists in electrical apparatus on account of the requirements of insulation has been the constant labor of designers, and while there has been a great advance in this direction, the problem is by no means solved as yet. By many builders the question of life has been made secondary to that of a higher efficiency.

It has been asserted that among the accidents that occur to dynamos and motors, fully 95 per cent. are directly attributable to the breaking down of the insulations, and yet the modern practice in designing dynamos and motors is to allow a minimum of space for insulation

in order to secure a maximum efficiency. This of course creates a necessity for a higher grade of insulation than ever before required—material having a high insulating value per mile in thickness as well as uniformity of such value; and above all, the property of elasticity so that it may withstand a considerable amount of bending—to which insulations are necessarily subjected in conforming them to the work—without cracking, as minute cracks in an insulation, however high in initial value, will of course reduce this value very materially, as is best illustrated in the case of mica. The higher the insulating value per mil, the more important this becomes. There has lately been placed on the market an insulation which claims to fulfill these requirements in a marked degree, by the Empire Electric Insulation Company of Schenectady, N. Y., who use a cloth or paper base and by coating it with successive layers of pure linseed oil, which is first treated by a special process, obtain an insulation which seems to meet all the requirements of modern practice. This insulation is made in the form of sheets of cloth and paper and in tape, and also pressed into shape for armature slots.

A New Double-Voltage Dynamo.

A new machine called the Fuller double-voltage, automatic, constant potential dynamo is being placed upon the market by the Fontaine Crossing & Electrical Company, Detroit, Mch., for which a number of advantages are claimed. Among these are that the dynamo can be connected to any three-wire system without alteration in wiring throughout the building, and used equally as well with a two-wire system and for either of two voltages. For example, in a 100-hp generator the current can be taken at 110 volts or at 220, while any intermediate number of horse power from zero to full load can be taken at either voltage or both at the same time. The dynamo is, in fact, practically two machines in one. The company guarantees all machines to regulate within two volts from zero to full load with brushes practically at a fixed point of commutation.

Particular attention has been given to the mechanical construction of this machine, insuring long life, as the bearings are long and large in diameter. The field windings are of high resistance, while the armature windings are of low resistance, insuring long life, from the fact that heating is almost entirely avoided. The bearings are self-oiling and self-aligning, insuring perfect lubrication. This type of generator is kept in stock in sizes from 10 to 100-hp, and larger sizes built to order. All machines are guaranteed, both mechanically and electrically, for the period of two years from the time they are put in service.

The advantage of this machine is particularly apparent where 220-volt moters are in use, and it is desired to put in a lighting plant, as in this case the motors can be supplied with a 220-volt current, and the lighting circuits yet run at 110 volts.

In large cities, where floor space is valuable, it is obvious that where one machine is put in to do the work of two, the expense is greatly decreased; there is one foundation dispensed with, one belt and one clutch pulley, as well as the actual floor space, saved. In the ordinary system of lighting and power service, where two voltages are desired, it has always been necessary to couple two machines in series, thus making the first cost of the plant extremely high. While the cost of a dnyamo of this description is slightly higher than a single voltage dynamo, it is low when compared with the cost of two machines. To those who are engaged in building steamships, locomotives and general iron-working industries, where electrical cranes and portable electric drills are used, a machine of this description is valuable, for the reason that a current of electricity can be carried to a great distance for power purposes on economical sized wire, while the remainder of the machine can be used for lighting purposes. This will also apply to business blocks, where electrical elevators, pumps, electric ventilating fans and small machinery are used, as it is a measure of economy to run this class of machinery at the higher voltage.

The Walker Street Railway Controller.

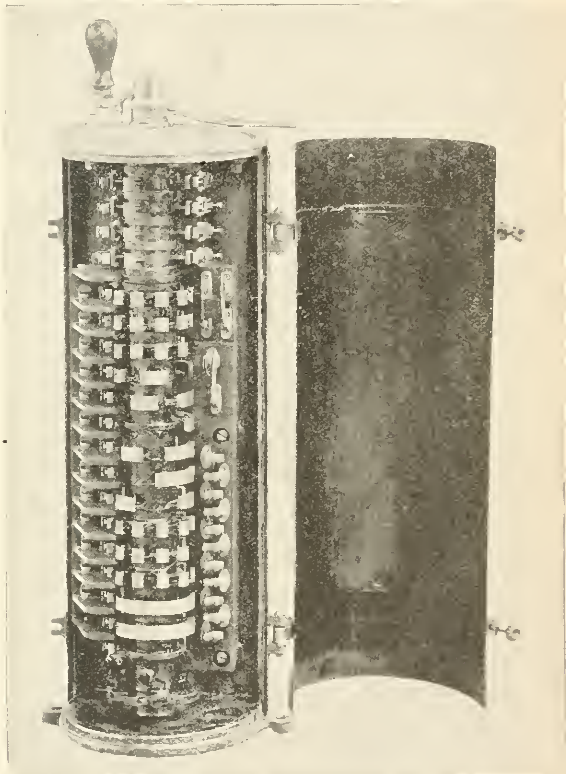
The Walker Manufacturing Company, Cleveland, O., which so recently brought out a new street railway motor equipment, has appreciated the fact that next in importance to the motor is the controlling apparatus for a car, and they have adopted the well-known plan of the series parallel controller, in which the two motors are first placed in series with each other, a sufficient rheostat being included in circuit to give the car a very easy and gentle start. While the motors themselves remain in series, this rheostat is cut out of the circuit by successive steps until the motors remain in circuit purely in series, in which position they will run at one-half their maximum speed.

This arrangement makes a very perfect control in operating the cars through crowded streets within the city proper and enables the car to creep along very slowly without the loss of power, common to the old rheostatic control. It also avoids the heating up of any of the apparatus. For higher speed work the controller changes the connections of the motor from series to parallel position. In doing this the rheostat is again brought into service, preventing any jerk at the time the change is made, and is finally cut out entirely, for high speed the motors being in parallel.

Under these conditions the motors will make a speed of from 20 to 25 miles an hour on a level, and with the larger-sized equipments will make a speed of from 35 to 40 miles an hour on a level. The great difficulty which has been experienced in a switch control of this kind is to so combine the changes that undue sparking and arcing at the contacts of the switch, in the controller cylinder, may be avoided.

This is done by breaking the arc up into many little arcs, so small that they are harmless; for instance, with 500 volts pressure an arc can be drawn out 5 inches in length before it will break; if this arc be split up into 20 small arcs in series with one another, they will be but ¼ inch in length and will become harmless. Usually the arc from a controller, if there is but one break in circuit, will be about 2 inches in length, but in The Walker Manufacturing Company's controller this is broken up into ten parts, making a minute spark of only about 1-10 inch in length.

The "series" breaks of the spark is repeated in every movement of the controller in such a manner that the sparking is exceedingly slight, and cylinders which have been in operation for months, on grades even of 11 and 12 per cent. with 30-foot cars show no signs of damage whatever from sparking. There being no apparatus in the controller which consumes energy, the greatest possible economy results in its operation.



The Walker Controller.

The illustration gives an excellent idea of the appearance and construction of The Walker Manufacturing Company's controller. It is built very substantially, and the cover has an overhanging apron of about 1 inch, which prevents water from leaking into the interior of the controller. The cover must be dropped down from under the apron when it is open, and when put in place, is pushed up and held in position by thumb screws. This not only seals the joint at the top but also at the bottom of the controller. Where the cylinder shaft passes through the top, a perfectly water-tight joint is secured, so that a hose playing on the top of a controller for 24 hours will show no sign of water leaking through at any point.

The reversing and cylinder handles are interlocking, so that the motors cannot be reversed while the current is on, nor can the cylinder handle be turned when the reversing switch is off. The handles of the controller (both cylinder and reversing) cannot be removed unless they are in the "off" position; this is a very desirable feature to prevent accidents in running cars. All the parts of the controller are interchangeable, and simple in construction and design, and all of the wearing parts are replaceable.

Financial Intelligence.

The Electrical Stock Market.

New York, Nov. 3, 1894.

ELECTRIC STOCKS have been forcedly quiet this week. For several weeks now speculative activity, except in odd moments, has heen an unknown quantity. It would seem that the revived conditions in business and the tremendous accumulation of funds at the various money centers would have resulted in the inception of a long-continued bull movement, and that electrical stocks, by reason of the prominence with which electric apparatus now figures in all industries, would hasten to enjoy some measure of advancing quotations. True, the rejuvination of commerce following on the settlement of the tariff agitation did result in a bull movement, but it was spasmodic. After the tentative advance came listlessness, to be interrupted at odd times only by successfully carried out bear campaigns. In consequence, electrical stocks to-day, though business conditions in the interval have immeasurably improved, are lower than a month ago, but merely as a result of professional manipulation.

GENERAL ELECTRIC matters will serve as an illustration. Bear attacks during the past month have been unrelenting, and the stock at times (what with the apparent unwillingness of insiders to reuder stock market supports, and the ease with which some long holders of the stock have been scared into liquidation) has been very weak. Yet its business, according to official announcements, continues to improve. Business returns for October, will, it is figured, show an increase all the way from 50 to 100 per cent. over the business of October, 1893. Press dispatches have it that the Schenectady plant of the General Electric Company has so many pressing orders on hand that the management has been obliged to send some of the work to the Thomson-Houston works at Lynn, which the latter plant is well equipped to do, so as to relieve the pressure on the Schenectady works. This additional call will entail the employment at Lynn of an additional force of about 400 operatives. One of the cheerful announcements effecting the company just made is the statement that the transfer books show a material increase as compared with a year ago, in the number of individual shareholders, while the number of shares in brokers' names is declining. An executive officer is quoted as saying: "There has been enormous buying of General Electric below 36 by interests which already have heavy lines. Owing to the wide nature of the holdings, the borrowing of the stock is a comparatively easy matter, and for this reason the heavy short interest which exists is not manifest." (It is on scaring this large and unwieldy short interest into cover that the friends of the company now mainly base their hopes of a rise.) This same official adds: "It is extremely improbable that any action will be taken looking toward a correction of the impairment of the capital before spring, and it is not by any means certain that it will be done at that time. At recent meetings of the Board of Directors the matter has not been presented or discussed in any form. The company, however, is making money, and is creating a surplus which is being used in making judicious loans and investments." One of the week's rumors had to do with President Coffin, who, it was stated, contemplated retiring. This is officially denied.

FORT WAYNE ELECTRIC COMPANY trust receipts have been placed on the unlisted department of the Boston Stock Exchange. These receipts represent the stock deposited with the State Street Safe Deposit & Trust Company, of Boston, and held by it in connection with the committee, Moses Williams, Frank A. Day and J. N. Smith, for the protection of the minority interests. The capital stock consists of 160,000 shares, 80,000 of which are owned by the General Electric Company. The second installment of 40 per cent. on the Fort Wayne Electric Corporation 6 per cent. gold debenture bonds was called for on the first of this month.

ERIE TELEPHONE has this week been made the subject of several vicious attacks; the governors of the Stock Exchange have, in fact, been called upon to correct what is called a "mistake" in placing Erie Telephone on the list. In answer to the various reports set forth reflecting on its credit, this official statement is promulgated by the company: "Our sub-companies do not owe one dollar of indebtedness. The Erie Company has paid over $1,700,000 in the forty-three dividends declared since July, 1883. It pays for repairs and reconstruction $150,000 annually from the earnings, in addition to dividends, royalties and all operating expenses. The funds raised by the bond sales are invested exclusively in real estate, long distance, metallic circuit and underground extensions." So far from the attacks harming the stock, it closes for the week at a slight advance.

BELL TELEPHONE stockholders, as intimated last week, will hold a special meeting in Boston on November 15, to accept or reject the act of the last Massachusetts legislature. The new stock is to be offered to stockholders at such price as may be determined by the Commissioner of Corporations, to be fixed under the provisions of the law. This will, it is expected, be the average price of the stock on the day of the meeting. Nothing, it is reported, has been done towards underwriting the stock, and it is not probable that anything will be, as the law provides that all stock not taken by stockholders shall be sold at auction. The stock continues weak. The net output for October was 3,346 instruments, a gain of 5,028 over October, 1893, when there was a deficit. Since December 20, 1893, the gross output has been 71,206, a loss of 1,085, and the net output 12,078, a decrease of 7,693.

AMERICAN DISTRICT TELEGRAPH, a stock not much quoted, is inclined to weakness, inasmuch as it is reported that at the meeting of the Board of Directors to be held next week the usual dividend will be passed by. Decreased earnings are given as the reason.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES trustees, as announced last week, have purchased another lot of 499 shares of preferred stock at an average price of 100.19, making a total of 16,343 shares already cancelled.

THE NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY, in declaring its dividend this week of $1 per share, has increased the annual dividend rate to 4 per cent., as against $3.50 per share distributed during 1893. The new Haymarket Exchange soon to be opened in Boston will greatly facilitate operations and also result in large economies.

CHICAGO EDISON COMPANY stock is now quoted at from 120 to 130, which is somewhat lower than former figures. There has recently been more than the usual amount of trading in the stock so that prices naturally reached the normally low rates. New York brokers offer 125 for this security.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	–	50
Edison Electric Ill., New York	100	100	101
" " " Brooklyn	100	110	112
" " " Boston	100	128	130
Cichago Edison " Chicago	100	120	130
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	12	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	35	35½
General Electric pref	100	63	65
Interior Conduit & Ins. Co.	100	20	30
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref	50	52½	53

BONDS.

Edison Electric Ill., New York	1,000	107¼	107¾
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	86	88

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	194½	195
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
Central & South American Telegraph	100	101½	105
Commercial Cables	100	125	145
Erie Telephone	100	53⅞	54
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
*New England Telephone	100	67	69
Postal Telegraph-Cable	100	54	60
Western Union Telegraph	100	87	88

* Ex-div.

New Incorporations.

THE MISSOURI DISTRICT TELEGRAPH COMPANY, Kansas City, Mo., capital stock $50,000, has been incorporated by L. C. Baker, M. D. Wood and J. W. Murphy.

THE MARYLAND SAFETY LIGHT, HEAT AND POWER COMPANY has been incorporated by Joseph Knell, Henry C. Barranger, E. C. Wallman, Geo. W. Knell and R. D. Bradley. The capital stock is $50,000.

THE PACIFIC ELECTRIC COMPANY, Pacific, Mo., capital stock $5,020, has been incorporated to erect a light and power plant. The promoters are A. H. Brown, A. Kappiz, G. H. Gross, S. B. Whitsett, C. C. Close, L. L. Seaburn and A. F. Mantel.

THE AMERICAN SAFETY HEAT AND LIGHT AND POWER COMPANY, Baltimore, Md., capital stock $50,000, has been incorporated by R. D. Bradley, G. M. Russum, Joseph Knell, G. W. Knell and G. L. Rogers, to manufacture appliances for lighting and heating buildings.

THE PIONEER ELECTRIC LIGHT COMPANY, of Barnet, Vt., capital stock $3,000, has been formed to furnish light and power in that town. H. E. Wilson, W. H. Burbank, Sherburn Moore, E. E. McGaffrey and H. A. Gilfillan, all of Barnet, are interested.

THE CHAPPAQUA ELECTRIC LIGHT AND POWER COMPANY, Chappaqua, N. Y., capital stock $30,000, has been incorporated, to manufacture and use electricity. Frank B. Sellick, Bertha G. Sellick, New York City, and Jas. S. Quinby, of Chappaqua, are interested.

THE EUREKA ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., capital stock $30,000, has been formed to manufacture and deal in electrical appliances, etc. Alfred Bevis, C. H. Longstretch, and Daniel W. Smith, all of St. Louis, are the promoters.

THE MOUNT GILEAD ELECTRIC LIGHT AND POWER COMPANY, Mount Gilead, O., capital stock $15,000, has been formed to build and operate an electric light and power plant. T. J. Carmack, Cleveland, O., and E. T. Bowen and M. J. Carmack are the incorporators.

THE ANCHOR ELECTRIC COMPANY, Portland, Me., capital stock $75,000, has been formed to manufacture and deal in electrical appliances and machinery. Philip M. Reynolds, Milton, Mass.; Horatio C. Hawks and Norman Marshall, Boston, Mass., are interested.

THE COOK ELEVATED ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $10,000,000, has been organized to construct elevated railways material and equipments relating thereto, etc. Mark Sands, Jas. E. Gaule and Carl H. Leopold are the incorporators.

THE HUNTERDON ELECTRIC COMPANY, Lambertville, N.J., capital stock $30,000, has been incorporated to manufacture, generate and store electricity for light, heat and power, etc. Wm. R. Bratten, Lenni; W. Alex. Robinson, and George W. Jacobs, Jr., Philadelphia, Pa., are the organizers.

THE MARBLE CITY WATER AND POWER COMPANY, Marble City, Col., capital stock $100,000, has been formed to construct a reservoir for water power and to furnish electric light to Marble City. Robt. Hayes Kline, Philadelpha, Pa.; Wm. W. Wood, Alex. J. Mitchell, Marble City, are the promoters.

THE CAPITAL ELECTRIC COMPANY, Springfield, Ill., capital stock $60,000, has been formed to produce and furnish electricity for light, heat and power, and to furnish electrical applicances, etc. John McCreery Peter W. Harts, Fred D. Buke, George Pasfield and Edwin A. Wilson are interested.

THE ATTLEBOROUGH STEAM AND ELECTRIC COMPANY, Attleboro, Mass., capital stock $65,000, has been formed to generate and use electricity for light, heat and power, and to manufacture and deal in machinery used for that purpose. Wm. A. Walton, Wm. H. Haskell, Homer M. Daggett, Jr., and Theron J. Smith are the interested parties.

THE COLUMBIA, IRONVILLE AND MOUNTJOY STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock $300,000, has been incorporated to construct, maintain and operate an electric railway. W. N. Boyer, Sam. R. Russell and Anthony H. Dillman, Philadelphia, are the promoters.

THE NATIONAL ELECTRIC COMPANY, Louisville, Ky., capital stock $20,000, has been formed to manufacture and sell electric cigar lighters and electrical devices of all kinds. James E. Gaither, J. W. Dawson, G. W. Eneby, J. C. Bowan, F. Eneby and J. M. Gilmore, Louisville, Ky., are the promoters.

THE AMERICAN INTERNATIONAL ELECTRIC COMPANY, Hawthorne, N. J., capital stock $200,000, has been formed to manufacture and sell electrical and other machinery and appliances. Henry B. Oakman, Frederick A. Bellevue, Brooklyn, N. Y., and Frank M. Ashley, Hawthorne, N. J., are the promoters.

THE CLEVELAND AND ELYRIA ELECTRIC RAILROAD COMPANY, Berea, O., capital stock $200,000, has been formed to construct, maintain and operate an electric railroad between Cleveland, Elyria, Wellington and Oberlin, and to furnish electric light, heat and power. F. T. Pomeroy, Berea, O., M. A. Sprague and A. W. Bishop are interested.

THE TYEE CONSOLIDATEED MINING COMPANY, San Francisco, Cal., capital stock $10,000,000, has been incorporated to do a mining and milling business; build and operate water works, electric light and power systems, steamboat lines and ferries, and to deal in merchandise. Maurice E. Griffin, Wm. B. Waycott and Richard E. Lewis are interested parties.

THE POWER DEVELOPMENT COMPANY, San Francisco, Cal., capital stock $500,000, has been incorporated to generate and develop water and electric power, deal in water rights, etc., and to transmit light and power for all purposes. Albert Miller, Edw. W. Hopkins, Chas. A. Grow, Chas. Webb Howard, San Francisco, and Carroll H. Beal, New York City, are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Nov. 3, 1894.

THE BROOKLYN CITY AND NEWTOWN RAILWAY COMPANIES have been granted the right to enter Flushing.

J. JONES & SON, 67 Cortlandt Street, New York, report business excellent. They still have some of the A. B. & C. sockets in stock and just at present are making a specialty of cotton cord.

MR. FRANK W. HAWLEY, vice-president of the Cataract General Electric Companies, in an interview in the Syracuse "Post" strongly favors the improvement of the New York State canals, and that in order to wield any influence whatever on the great problem of transportation the canals must not only be improved but also electric propulsion adopted.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, November 2, 1894.

WESTINGHOUSE, CHURCH, KERR & COMPANY announce the removal of their New Engalnd office from 620 Atlantic avenue to Exchange Building, 53 State street, Boston.

THE COLUMBIA ELECTRIC COMPANY, of Worcester, Mass., has just sold to the newly organized Grafton Electric Company, of Grafton, Mass., 25 miles of weather-proof wire.

THE HAWKS ELECTRIC COMPANY, of Boston, under the management of Mr. W. F. Fowler, will continue to do general construction work, and about December 1st will move into a new office on Franklin street.

MR. CHARLES H. POPE, who has hosts of friends in the electrical fraternity, owing to his connection with the mining and motor department of the Thomson-Houston Electric Company and with the Brown Electric Company as its cashier and bookkeeper, is now identified with the Thompson-Brown Electric Company, of Boston, as assistant treasurer.

MESSRS. LINTON & SOUTHWICK, of Worcester, Mass., manufacturers of switches, switchboards and electrical appliances, report businesss as rapidly improving with them, and orders on the increase. They have recently again considerably enlarged their manufacturing facilities to meet the demand for their well known specialties. Some novelties which they have been developing will appear in their forthcoming catalogue.

MR. J. E. TALBOT, well and favorably known to the electrical fraternity everywhere, one among the oldest of the "old timers's so far as service is concerned, and more recently for six years prominently identified with the Fort Wayne Electric Company, at Indianapolis, has become associated with Messrs. Linton & Southwick, of Worcester. We congratulate the latter firm upon securing the valuable services of Mr. Talbot and congratulate also Mr. Talbot upon the good connection he has made.

THE DAVIDSON VENTILATING COMPANY reports business as improving in their electrical department. They have just completed the installation of 200 lights in the Chardon Street Telephone Exchange, Boston; also a 250-light Wenstrom dynamo and wiring complete in the W. Warren Thread Works, Westfield, Mass. They have also closed a contract for a 450-light plant for the Howland Falls Pulp Company, Howland Falls, Me. This company has taken the New England agency for the well-known engines and boilers manufactured by the Phœnix Iron Works Company, who have their factories in Meadville, Pa.

THE PETTINGELL-ANDREWS COMPANY, of Boston, reports the receipt of large orders for commutator segments manufactured by the Billings & Spencer Company, of Hartford, Conn, and for which they are the United States and Canadian selling agents. They have also just made a good sale of incandescent arc lamps, and their sales of line wire recently have been very gratifying. Altogether they report business as exceptionally good, and notwithstanding the fresh competition they are obliged to encounter, owing to the ormation of new supply houses in Boston, they confidently expect to hold well their trade. Competition always acts as an incitant to energy, of which Mr. Andrews, Mr. Price and their attaches possess an abundance, and some lively "hustling" may be anticipated on their part.

THE FOLLOWING HANDSOME AND DESERVED TRIBUTE appeared this week in the Boston Record in its "Seen and Heard" column: "W. J. Denver, assistant general manager of the New Enlgand Telephone and Telegraph Company, is one of the busiest men to be seen on Boston's streets. Aside from his office duties, and they are diverse and numerous enough to need 18 hours out of 24 in the life of any ordinary man, he is obliged to personally visit many cities and towns of New England every week of his life, superintend extensive constructive operations in one direction, and the proper maintenance of miles of equipment in another, and all the time he must keep himself fully informed of every improvement in electrical science and if possible originate a few himself. I do not envy him his position no matter what his salary or however much he likes it, even if I could perform the duties."

THE NEW ENGLAND AGENCY of the Buckeye Engine Company has removed from 84 Kingston street to 620 Atlantic avenue, Boston, where it is represented as before by Mr. W. D. Hoffman. The Buckeye Engine Company are to be congratulated upon re-establishing themselves in this district, in which up to last spring it was not strongly represented. With its many engines now running in all of the principal New England cities it always has a first-class record to point to. One of its large plants, a 100-hp triple expansion, at the Hadley Company Holyoke, Mass., is very conspicuous for its economy and general excellence. The Buckeye Company could not possibly be better represented than it will be by Mr. Hoffman, who understands its engine thoroughly, owing to the fact that his father was so long identified with its New England branch of manufacture, in addition to which Mr. Hoffman has also represented the engine in the West.

THE THOMPSON-BROWN ELECTRIC COMPANY opened its new and capacious store at 97 High street, Boston, Thursday, October 25, and its managers and attaches have every reason to congratulate themselves upon the large number of well-wishers who responded to their invitation during the day and evening, as well as upon the numerous lette of congratulation which were received from many prospective customers in England. A light lunch was provided, during the dispatch of which an orchestra discoursed some lively music. The occasion was a happy one in every respect. President Thompson received a most hearty welcome from all present and the countenances of Messrs. Maybin W. Brown, F. E. Pettingell, and Herbert P. Brown beamed with joy over the kindly words, congratulations and best wishes which were spoken. The company is already the recipient of some good orders, which, coming so soon, were somewhat of a surprise.

THE O. C. WHITE COMPANY, of Worcester, Mass., state that there has recently been an unusual demand for its adjustable incandescent lamp holder. Among the recent sales are 250 holders to the Stanley Electric Manufacturing Company, of Pittsfield, and 150 holders to Kent & Stanley, jewellers, of Providence, R. I. This holder is adapted more especially for machine shop work, but its applications are numerous. It possesses several features of merit and received an award at the World's Fair; it holds a lamp at any angle or position desired without the inconvenience of a dangling cord, and it "stays put." A ball and socket joint on the ceiling or wall allows an arm to move in any direction, and a second arm, sliding, and also jointed on the first, lengthens or shortens the total reach of the device, and by tension joints the lamp with its socket and shade can be brought close to a piece of work in a machine and handled with ease and safety. It is a decided improvement both from the freedom from injury to a swinging lamp, and by the lamp being held close to the work, and at the same time being easily pushed on one side.

THE ANCHOR ELECTRIC COMPANY, of Boston, Mass., a newly organized corporation, is announced as succeeding to the business of the Brown Electric Company, the supply business of the Hawks Electric Company, and the supply business of the Iona Manufacturing Company, all of which have been conspicuous among the electrical industries of Boston for a number of years. The new company has located at 71 Federal street, near Franklin street, Boston, where it will have handsome and spacious quarters for the conduct of its business, the ground floor embracing about 2,700 square feet, and the basement about 800 feet. It will carry a most complete stock of "up to date" supplies and specialties for electric lighting and electric railway purposes, and in fact everything needed in the electrical line. This combination makes the Anchor Electric Company at once a formidable competitor in the electrical supply field. The Brown Electric Company has always received good business recognition, the supply department of the Hawks Electric Company had grown to quite large proportions so as to interfere considerably with its construction department, and the Iona Manufacturing Company was about in the same position, the conduct of its supply business conflicting quite seriously with the manufacture of its various electrical specialties. From a managerial standpoint the new company occupies an enviable position of strength. Mr. H. C. Hawks, of the Hawks Electric Company, an energetic business man and who enjoys a deservedly excellent reputation in the electrical field, is its president; Mr. P. M. Reynolds, treasurer of the Brown Electric Company, and formerly identified with the mining and motor department of the Thomson-Houston Electric Company, noted for his reliability and business sagacity, is its treasurer, and Mr. Norman Marshall, of the Ionia Mfg. Company, shrewd, calculating and far-seeing in business matters, is its vice-president and secretary.

CANADIAN NOTES.

OTTAWA, Nov. 1, 1894.

LONDON, ONT.—A charter has been issued to the London Electric Company, with a capital of $250,000.

PETROLIA, ONT.—A charter has been granted to the Petrolia Electric Light, Heat and Power Company, with a capital of $25,000.

OTTAWA.—A petition asking the Electric Railway Company to extend its line to Billings' Bridge is now being circulated for signatures.

THE TOWN COUNCIL OF AYLMER will meet especially to pass upon the proposals of Contractor Viau's Electric Railway Company.

THE OTTAWA CAR COMPANY has shipped three vestibule cars for the St. John (N. B.) Electric Railway, equipped with Westinghouse motors.

HAMILTON,—B. B. Osler, has written to the Mayor of Dundas, proposing that

or a bonus of $25,000 he will convert the Hamilton and Dundas street railway into an electric road.

MONTREAL.—Duncan McDonald has been appointed superintendent of the Montreal Street Railway. Mr. McDonald has been acting superintendent since Mr. Franklin's resignation.

THE ANNUAL MEETING of the shareholders of The Toronto & Scarboro Electric Railway, Light & Power Company, will be held on November 13th, at Toronto, for the election of directors.

JOHN P. MULLARKEY, of Montreal, the new General Manager of the Montreal Island Belt Railway, takes charge of his position Nov. 2. Mr. Mullarkey is a young man, having been born Oct. 11, 1857, at Aylmer, Que.

LONDON, ONT.—All the street cars in the city have been fitted with automatic registers which count the actual number of passengers carried by each car during the day. The amount in the money boxes must correspond with the registers.

News of the Week.

Telegraph and Telephone.

BELOIT, WIS.—G. L. Call, proprietor of the Beloit Electric light plant, has been granted a franchise by the Common Council for the construction and maintenance of a telephone exchange.

INDIANAPOLIS, IND.—The Phoenix National Telephone Company, of Indianapolis, has been organized with a capital stock of $100,000. The directors are: Martin Caldwell, John W. Parrish and Jacob Frankel.

FOSTORIA, O.—A new telephone exchange in competition with the Bell Telephone is an assured fact for this city. The new company will be known as the Citizens' Telephone & Message Company, and will begin the construction of a plant next week.

Electric Light and Power.

EAST ORANGE, N. J.—It appears to be the prevailing opinion that an electr light plant would be of the greatest benefit to the township.

MOBERLY, MO.—The organization of a company is proposed to establish an electric light plant. J. S. Bowers can be addressed.

LEWISTON, ME. The Council has ordered the enlargement of the portion of the pumping station which is to be used by the electric light plant.

HARRISBURG, Pa.—The foundations for the electirc light plant of the Cumberland Valley Electric Light Company, at Riverton, have been begun by contractor Alleman.

DUNLAP, IOWA.—A movement is now on foot among the business men to loan the city money with which electric lights will be operated in connection with the water works.

CANTON, O. A franchise has been granted to the Canton Light, Heat & Power Company to construct, maintain and operate an electric light system. H. G. Schaub is City Clerk.

GRAHAM, VA.—The Graham-Bluefield Electric Light & Power Company has made the necessary financial arrangements for building its proposed plant and will commence work at once.

WEST NEWTON, MASS.—A hearing has been granted the Newton & Watertown Gas & Electric Lighting Company on the proposed establishment of a municipal plant for the city.

PORTSMOUTH, N. H. At a meeting of the Board of Aldermen, Alderman Ham moved that the city clerk be authorized to issue proposals to light the city five years, which was accepted.

PORT HURON, MICH The Council at a a special meeting decided to present to the voters at the coming election a proposition to bond the city for $40,000 for the purchase of an electric light plant.

BUFFALO, N. Y.—The Niagara Falls Power Company has petitioned the Buffalo Board of Aldermen for permission to erect poles in that city for the purpose of transmitting electric power from their plant.

PITTSBURG, PA.—An electric light plant is about to be installed in a town near Pittsburg, arc and incandescent. Prices on goods can be mailed to W. Staub, superintendent, 1321 Bluff street, Pittsburg, to be in before Nov. 15.

GRAND RAPIDS, MICH.—The Grand Rapids School Furniture Company contemplates building a new engine house. They will put in a new engine to run the factory, and use the present engine to drive an electric lighting plant.

CUTHBERT, GA. The engineer has been ordered to proceed with his work in making surveys and preparing plans, specifications, etc., for the electric light plant and water works system recently voted for. Robt. L. Moye is Mayor.

BROOKLYN, N. Y. The Mutual Gas & Electric Company, A. W. Wannamaker president, and Chas. H. Selig, secretary, applied to the Board for a franchise to make and supply gas and electricity for lighting purposes and erect the necessary poles, etc.

WASHINGTON, D. C. Sealed proposals will be received until November 10th for manufacturing and placing in position in complete working order in the United States Buildings, at Houston, Lewiston, Me., Fremont, Neb., and Staunton, Va., combination gas and electric light fixtures. C. S. Hamlin is Acting Secretary of the Treasury, Washington, D. C.

SYRACUSE, N. Y. It is announced that a new company will apply to the Common Council for a franchise permitting it to furnish electric lights and electricity for power purposes, to be known as the Citizens' Company. The capital is $150,000, and those interested are Wilber S. Peck, Judge S. B. Hahn, W. K. Pierce, and Paul T. Brady, all of Syracuse.

The Electric Railway.

APPLETON, WIS. The Inter-Urban Electric Railway has been granted a [illegible]se to construct a railway.

LITITZ, PA.—About 70 men are at work grading for the electric railroad between Lititz and Kissie Hill.

TAMPA, FLA.—R. W. Easley and W. H. Kendrick propose to build an electric street car line direct to Palmetto Beach.

BATLE CREEK, MICH.—The contract to rebuild the Battle Creek Electric Street Railway, has been given to D. A. McGugan, of Davenport, Iowa.

JERSEY SHORE, PA.—Engineers will commence to make a survey of the route of the proposed trolley line from Jersey Shore to Nippenose Valley.

PENN YAN, N. Y.—Some trouble is being encountered in securing the right of way for the proposed new road from Parker's to Sturdevant's Landing.

STEVENS POINT, WIS.—The Stevens Point Electric Light Company has been granted a franchise for putting in an electric street car system at that place.

MARLBORO, MASS.—The stock of the proposed electric railroad between Marlboro and Westboro has nearly all been disposed of. The road is capitalized at $100,000.

PORT JERVIS, N. Y.—The Delaware Valley Electric Railway has secured a piece of property of Edward Bush, on which it will locate a tower house near Marshall's creek.

SOUTHINGTON, CONN.—A plan is under way, under the management of L. V. Walkeley, of Southington, to build an electric road from Meriden to Southington.

LITTLE ROCK, ARK.—A petition has been submitted to the city council urging the granting of a street railway franchise to H. F. Auton and Messrs. Fuller & Moss.

BOWLING GREEN, KY.—The right of way for an electric railway from Bowling Green to Perrysburg and Portage has been granted to E. H. McNight by the Commissioners.

HEMPSTEAD, L. I., N. Y.—The Hempstead Traction Company has made application for permission to operate a surface electric railway through certain streets of the village.

LEWISTON, N. Y.—Considerable interest is felt over the prospect of an electric railroad being built at once from the gorge at Niagara Falls to this place. Right of way has been secured.

CLEVELAND, O.—The County Commissioners have granted L. M. Coe, of Berea, a franchise to construct and operate an electric railroad to connect Chestnut Ridge with the Berea line.

COLESVILLE, N. Y.—An extension of the trolley system from Lancaster to Cowlesville will, it is said, soon be made. Col. A. Haskins and other citizens are at work raising the money required to extend the road.

GLOUCESTER, MASS.—The Gloucester & Rockport Street Railway Company began work on the electric road from Bass avenue across Good Harbor Beach to Brier Neck, a distance of 2½ miles.

BEREA, O.—The County Commissioners granted the Cleveland & Elyria Electric Road a franchise through the county to connect with the Cuyahoga franchise. L. H. Coe and A. H. Pomoroy are the promoters.

IRVINGTON, N. J.—A meeting was held by the Board of Trustees for the purpose of hearing the wishes of the residents of Irvington and the representatives of the electric railway companies concerning franchises.

ANNAPOLIS, MD.—H. Y. Brady, of Smith & Brady, contractors, of Baltimore, is preparing plans for building the electrical railroad of the Annapolis, Bay Ridge & Brighton Beach Railway Company.

KEY WEST, FLA.—John Jay Philbrick and associates are not ready yet to make arrangements towards building and equipping their electrical railroad. As soon as a charter is secured they will be ready to proceed with their plans.

FORT MADISON, IOWA.—The Fort Madison Street Railway Company is considering the matter of changing the motive power to electricity and extending its lines. J. B. Morrison of the Morrison Mfg. Co., is president.

SCRANTON, PA.—An ordinance has been passed permitting the Scranton North End Street Railway Company to construct its tracks and erect the necessary poles and operate the same by electricity on a number of streets.

HOMESTEAD, PA.—At the meeting of the Homestead Council the right of way ordinance to the Homestead Traction Company was finally passed. Mr. Bryce was appointed to investigate the project of erecting a borough electric lighting plant.

BALTIMORE, MD.—The Baltimore Traction Company intends building a half-mile of new road to connect its Arlington line with the Gwynn Oak Railway. The extension of its Edmondson avenue line to Mount Washington is also proposed.

LYKENS, PA.—The Williams' Valley Street Railway Company has been granted a charter at the State Department. Its capital stock is $100,000 and it is proposed to build a line from Reimer City, Schuylkill County, to Lykens, a distance of twelve miles.

POTTSTOWN, PA.—The Ringing Rocks Electric Railway Company held a meeting in Treasurer Shaner's office and transacted considerable business in connection with the proposed extension of the line from Ringing Hill to Boyerstown and New Berlinville.

MARSHALL, MO.—A syndicate composed of a number of California capitalists is carrying on negotiations at Marshall looking to the building of an electric railway between Miami and Sedalia by way of Marshall, Blue Lick and the great coal mines in that vicinity.

BALTIMORE, MD.—The Baltimore Traction Company has decided to substitute electric power on its Gilmore street cable line. The cable plant will be kept in condition for use in emergency. The company is also considering the changing of its Druid Hill avenue line to electricity. F. H. Hambleton is chief engineer.

EAST WAREHAM, MASS.—At the annual meeting of the East Wareham, Onset Bay & Point Independence Street Railway Company, the following officers were elected: Thomas B. Griffith, president; Isaac B. Eldridge, treasurer; Benj. F. Gibbs, clerk. A committee was empowered to investigate the question of electric motive power.

NORRISTOWN, PA.—The officers of the Norristown and Chestnut Hill Passenger Electric Railway have been in Norristown arranging with the town

council for the immediate construction of their line. The company will begin work immediately and expect to have it completed and a circuit formed with Philadelphia by next December.

BROOKYLN, N. Y.—The new power station for the Nassau Electric Railway Company, at Brooklyn, N. Y., will be 10 feet wide and 150 feet long, and will be constructed entirely of iron and steel, the whole designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The roof will have an anti-condensation corrugated iron roof covering.

CATLETTSBURG, KY.—The City Council of Catlettsburg, Ky., has decided to sell the franchise for an electric street railway through the city on November 12, which is virtually surrendering to the local line the right that has been contested and withheld for the past three years. The line will be completed as soon as possible after that date.

NIAGARA FALLS, ONT.—A number of gentlemen, headed by Wm. Kyle, E. Hewitt and Robert Y. Sexworth from Toronto, and W. Wright of Niagara Falls, Ont., appeared before the council with a plan to build an electric road from Niagara Falls, Ont., to Chippewa, and use the old Niagara Falls and Drummondville road franchise through the town, the cost to be $350,000.

CHESTER, PA.—The people interested in the construction of the Philadelphia & Delaware Electric Railway Company, which has a charter to construct a trolley road from Philadelphia to the Delaware State line, and has extensive franchises in South Chester, drove over the route. They were joined in this city by their counsel, Jos. H. Hinkson, and say they will commence operations early next week.

WEYMOUTH MASS.—The Braintree & Weymouth Street Railway Company has been organized. The directors are John Keyser, Braintree, D. A. Brooks, Braintree, Edward W. Hunt, of Weymouth, and others. John Kelley was chosen president. It was voted that the president be authorized to petition the selectmen of Weymouth at the earliest possible time for a location from Lincoln Square to South Weymouth.

KANSAS CITY, MO.—The Kansas City Traction Company, which has recently been chartered, has for its purpose the construction of an electrical railroad that will connect the Kansas City Cable Railway with the West Side Electric Railway, of Kansas City. B. S. Coler, of Brooklyn, N. Y., is president; W. H. Lucas, of Kansas City, Mo., secretary, and F. D. Hutchings, of Kansas City, treasurer. It is said that the line will be built at once. The capital is $1,000,000.

McKEESPORT, PA.—There is another electric line in sight for McKeesport. The gentlemen interested have been thinking seriously of extending Schenley Park and Highland electric railway from the entrance to Schenley Park at Squirrel Hill, Pittsburg, to Brown's Hill bridge at Brown Station, and thence through Hempstead. They have decided to extend this line to Duquesne to connect with the White Traction line. R. G. Wood is interested, and S. J. McFarren is the manager of the road.

Miscellaneous Notes

THE UNIVERSITY OF ILLINOIS on Nov. 15 will dedicate its new Engineering Hall and the same day President A. S. Draper will be inaugurated.

THE FEEDER AND MAIN SUIT.—Judge Green, on October 26, at Trenton ordered a reversal of his decision in the case of the feeder and main patent, and ordered that the defendant have judgment against the complainant, the Edison Electric Light Company, for the amount of costs taxed by the Clerk of the U. S. Circuit Court of Appeals; also that the defendant have judgment against the complainant for the further sum of $6,411.57, amount of costs taxed by the Clerk of the Trenton Court.

EXHIBITION OF AMERICAN MANUFACTURES.—The Lodge & Davis Machine Tool Company and other large manufacturers of Cincinnati have entered heartily into the movement to organize Exhibitions of American Manufactures in Mexico and the South American republic in conjunction with international displays from those countries, through which it is hoped that the market for goods manufactured in the United States may be extended. Owing to the large trade of Cincinnati with these countries and its central location it is proposed that the suggested convention of American manufacturers be held there. At this convention it is proposed to settle the details of the plans, whose realization should meet with the encouragement of every one who desires the United States to occupy the position it should in the trade with our sister republics.

NATIONAL SCHOOL OF ELECTRICITY.—A public meeting of the National School of Electricity was held in Philadelphia on Tuesday evening, October 30th and was presided over by Mr. Addison B. Burke. The greater part of the meeting was devoted to an explanation of the object and methods of this school, by the Secretary of the Corporation, Mr. J. Allen Hornsby. An address was made by Mr. W. W. Porter of that city, in which he called attention in an interesting way, to the almost innumerable applications of electricity at the present time, and showed how important it was even to such men as lawyers, doctors, merchants, etc., to have some knowledge of electricity. Prof. Houston being out of town, did not address the meeting as was announced. The meeting was well attended and the Secretary announced that he believed there would be enough applicants in Philadelphia to form at least four classes of about thirty each.

Trade and Industrial Notes.

THE S. K. C. SPECIALTY COMPANY (Stanley-Kelley-Chesney), with a capital of $12,500, has been organized in Pittsfield, Mass., for the manufacture of small motors and minor electrical machinery.

THE FONTAINE CROSSING AND ELECTRICAL COMPANY, Detroit, Mich., in a twelve-page catalogue, describes the various electrical apparatus which it manufactures, which include the Fuller automatic single and double voltage dynamos, Fuller stationary motors and Fuller combination fan motors. A long list of flattering letters commendatory of the Fuller apparatus maintain the high claims made for the efficiency and reliability of this machinery.

THE YOUNG LOCK NUT COMPANY, 150 Broadway, New York, through its representative, R. D. Stewart, exhibited the Wrought Iron Bridge Company's flexible bracket for trolley lines at the Atlanta Convention. Our report inadvertently stated that no representative was present in connection with this exhibit. The Young Nut Company also exhibited its gravity nut lock, Brownley injector, the Brownley brake shoe and the Technic Electrical Work's rail bond.

THE OHIO BRASS COMPANY reports that its recent exhibit at the Atlanta Convention, which attracted so much attention, has already borne fruit in the shape of orders from many new customers. The increasing number of orders indicate a steady and healthy growth of business, and it may be said that this firm now ranks among the leading manufacturers of electric railway material. It reports sales of considerable size for the month of October, the list including no less than 30 prominent electric railways.

WILLIAM BIDDLE, JR., AND JAMES G. BIDDLE announce that their connection with Queen & Company, incorporated, Philadelphia, as joint managers of the physical and electrical departments has ceased. Mr. James G. Biddle, who was manager for five years of the sales department, comprising physical and electrical instruments, can be addressed at 119 S. Fourth street, Room 28, from where he will be pleased to communicate with prospective purchasers of scientific apparatus.

THE PHILADELPHIA ENGINEERING WORKS have just completed contracts with the Carnegie Gas Company, Pittsburg, for three 30x60-inch gas compressors, each driven by a 32x60-inch Philadelphia Corliss engine of their rolling mill type. They have also contracted with the Pittsburg Natural Gas Company for a pair of 30x60-inch gas compressors, each driven by a 24x60-inch Philadelphia Corliss engine. Also a pair of 30x60-inch gas compressors for the Ohio Valley Gas Company, each driven by a 26x60-inch Philadelphia Corliss engine. Also with Marshall Bros., of Philadelphia, for an 800-hp tandem compound condensing engine, of their rolling mill Corliss type, to drive tinplate mills. They are just shipping for the Chamberlain Coal Company, Pottsville, Pa., two 34x60-inch Philadelphia Corliss hoisting engines complete, with drums, brakes, etc. Also two 14x36-inch heavy Corliss engines for the same company to be used for their coal breaker, and to the Standard Steel Works, Burnham, Pa., a 15-ton revolving open-hearth steel furnace, together with gas producers, piping and chimneys. Their works are operated full force night and day, and prospects are very good for plenty of trade in the future.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports an increasing number of sales of apparatus for the month of October. The company now has orders ahead for three months and is operating its entire plant overtime until 10 o'clock every night. The following is a list of sales: Hartford & West Hartford Street Railway Company, Hartford, Conn. (2d order), 180-kw 500 volt generator; Hartford & West Hartford Street Railway Company, Hartford, Conn. (3rd order), 180-kw 500 volt generator; Bloomington City Railway Company, Bloomington, Ill., 100-kw 500 volt generator; Amory Manufacturing Company, Manchester, N. H., 80-kw 120 volt generator; Chalres R. Lewis Clothing Manufacturing Company, Belleville, Ill., 30-kw 120 volt generator; Stamford Hotel, Chicago, Ill., 45-kw 120 volt generator; John Jermyn, Scranton, Pa., 100-kw 500 volt generator; Southwest Virginia Improvement Company Pocahontas, Va., 60-kw 220 volt generator; Somers' Fuel Company, Belle Vernon, Ohio, 60-kw 220 volt generator; J. Holt Gates, Chicago, Ill. 60-kw 220 volt generator; J. Holt Gates, Chicago, Ill., 30-kw 120 volt generator; J. Holt Gates, Chicago, Ill., 100-kw 500 volt generator; Burtis & Howard, Minneapolis, Minn., 11-kw 220 volt dynamo; Stanley Electric Company, Pittsfield, Mass., 2-kw Manchester exciter; Jon s & Lamson Machine Company, Springfield, Vt., 350 light dynamo; Warren Shaw & Company, South Peabody, Mass., 250 light dynamo; Lewis Anderson & Company, Skowhegan, Me., 600 light dynamo; George Pappert Manufacturing Company, North Milwaukee, Wis., 150-light dynamo; H. B. Coho, New York City, 450 light dynamo; Cobb, Bates & Yexra, Fall River, Mass., 600 light dynamo; Chambers Electric Light & Power Company, Truro, N. S. (6th order), 600 light dynamo; Ohio State University, Columbus, Ohio (2d order) 15-hp Manchester motor; Sheriff of Hampden County, Springfield, Mass., 5-hp Manchester motor; Aetna Electric Works, Hartford, Conn., 6-hp Manchester motor; Charles R. Lewis Clothing Manufacturing Company, Belleville, Ill., 3-hp Manchester motor; Harry S. Anderson, Springfield, Mass., 600 ampere speial dynamo. Shipments consisting of further October orders, and former orders: Bartram Hotel, Philadelphia, Pa., 245-kw direct connected machines; New Pittsburg Coal Company, New Pittsburg, Ohio, 60-kw 220 volt generator; Morris Coal Company, Sand Run, Ohio, 60-kw 220 volt generator; Henry R. Worthington & Company, Brooklyn, N. Y., 45-hp 220 volt generator, Jones Bros. Electric Company, Cincinnati, Ohio (7th order), 50-hp 220 volt generator; Connecticut River Paper Company, Holyoke, Mass., 700 light dynamo; Grenada Hotel, Chicago, Ill., 450 light dynamo; Leafe Bros., Winchester, Va., 50 light dynamo; Major & Loomis, Hartford, N. C., 25 light dynamo; George W. Furbeck, Chicago, Ill., 250 light dynamo; Badger Lumber Company, Kansas City, Mo., 100 light dynamo; Henry R. Worthington & Co., Brooklyn, N. Y., 600 light dynamo; Diamond Machine Company, Providence, R. I., 250 light dynomo; North Packing & Provision Company, Somerville, Mass., (3d order), 1,000 light dynamo; H. S. Sands, Fairmont, West Va., 450 light dynamo; Karl Knitting Mill, Northville, N. Y., 75 light dynamo; Bay State Distillery Company, East Cambridge, Mass., 350 light dynamo; Phelps Publishing Company, Springfield, Mass., 20-hp Manchester motor; Connecticut River Paper Company, Holyoke, Mass., 215-hp Manchester motor; Machinery Supply Company, Los Angeles, Cal., 5-hp Manchester motor; Meriden Britannia Company, N. Y. City (2d order), 5-hp Manchester motor; Machinery Supply Company, Los Angeiles, Cal., 3-hp Manchester motor; Machinery Supply Company, Los Angeles, Cal., 10-hp Manchester motor; B. F. Sturtevant & Company, Chicago, Ill., 10-hp Manchester motor; Electric Construction & Engineering Company, Detroit, Mich., 3-hp Manchester motor.

Business Notices

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs, doing business at Rochester, N. Y., has been mutually dissolved.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 23, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

527,826. CARBON FOR ELECTRIC LIGHTS: E. G. Acheson, Monongahela City, Pa. Application filed Aug. 25, 1894. This comprises an outer body of carbon and a core of carbide of silicon.

528,055. MAGNETIC SEPARATORS; W. H. Williams, Newark, N. J. Application filed Jan. 29, 1892. This comprises a hollow perforated magnetic separating drum, connections for producing an air blast from the interior of the drum outward through the perforated separating wall of the drum.

528,127. CIRCUIT CHANGER FOR ELECTRIC SIGNALING SYSTEMS: J. F. Hunter and S. H. Lough, Seattle, Wash. Application filed Sept. 2, 1892. This comprises a plurality of line circuits with signal transmitting devices, receiving instruments in each circuit, an extra battery and circuit normally disconnected from the main line circuits, and a circuit changer in each main line circuit for connecting the extra battery circuit with the main line.

UNITED STATES PATENTS ISSUED OCTOBER 30, 1894.

528,149. TROLLEY CATCHER; Woodson D. Cobb, Fort Worth, Tex. Application filed May 29, 1894. The combination with a pivotal trolley wheel of a spring actuated supporting frame, a catch for connecting the pole to the frame, a trip arranged at the free end of the pole for engagement with a trolley wire upon the dismounting of the trolley wheel from the wire and connections between the trip and catch.

528,184. ELECTRIC ARC LAMP; Rudolph Segedahl, Chicago, Ill. Application filed February 26, 1894. The combination with an electric arc lamp provided with means adapted to sustain the weight of same, of a resistance consisting of two parts, interposed between the circuit terminals and lamp terminals respectively, and secured to or located on each side of the frame structure of the lamp.

528,185. AUTOMATIC ELECTROMAGNETIC CUT-OUT; L. T. Stanley, Brooklyn, N. Y. Application filed August 22, 1893. The combination of a jacketed coil, a reciprocating core, the pivoted switch lever, co-operating contacts and magnetic pus rod extending through a diamagnetic bushing in the end of the jacket under the switch lever.

528,188. ELECTRIC TRANSFORMER; Elihu Thompson, Lynn, Mass. Application filed January 29, 1890. A core for transformers built up of laminæ or plates of sheet iron assembled together, each plate having a shorter and a longer arm, the inner length of the shorter arm being made approximately equal to the width of the longer arm and two sets of sai plates locate in each laminæ and the plates of each set placed with the ends of the shorter arms against the inner sides of the longer arms so as to leave two rectangular openings for the coils of wire.

528,189. THERMOSTAT; David W. Thompson, Chicago, Ill. Application filed November 19, 1889. A thermostat comprising a base, a compound strip or coil mounted thereon, independently adjustable contact points, a plate supporting the contact points and movably supported upon the base, and an adjusting screw engaged with the base and the movable plate for adjusting the latter, the base being provided with a plurality of wires secured at their ends in the base and placed over the surface of the same to afford bearings for the plate.

528,204. ARMATURE FOR DYNAMO ELECTRIC MACHINES AND METHOD OF MAKING SAME; Thos. H. Hicks, Detroit, Mich. Application filed July 14, 1894. In an electric machine, an armature having its conductor bobbins each composed of two divisions, with an encircling band of insulation between the divisions and the terminals of all the bobbins proceeding from the outer layer of the bobbins.

528,206. CONDUIT ELECTRIC RAILWAY; Julius L. Hornig, St. Louis, Mo. Application filed February 19, 1894. In combination with a conduit casing, of a plow having a depression in its upper edge and a projection having a chamber therein for carrying a lubricant.

528,243. RHEOSTAT; Montgomery Waddell, Bridgeport, Conn. Application filed September 6, 1893. A plate for rheostats having one or more of its edges crimped.

528,245. ELECTRIC RAILWAY SIGNAL; A. J. Wilson, Port Chester, N. Y. Application filed November 21, 1892. The combination of a series of track sections, each divided into a series of sub-sections, the inner sub-section of each section being also the outer sub-section of the succeeding section, a normally closed track circuit for each sub-section, an over-lapping signal circuit for each track section adapted to be operated upon a change in the electric condition of the track circuits.

528,246. ELECTRIC RAILWAY SIGNAL; A. J. Wilson, Port Chester, New York. Applicaiton filed December 16, 1892. The combination of a block of track divided into two or more sub-sections, a track circuit for each sub-section, a normally open signal circuit, means preceding the block for closing the signal circuit to operate the signal, and means included in the signal circuit for breaking it upon a change in the electric condition of each of the track circuits of the block.

528,268. OHM-METER; A. H. Armen, Lynn, Mass. Application filed April 21, 1894. This consists of a single cylinder and two distinct sets of resistance wires coiled about it at its respective ends, and with two distinct sets of brushes bearing upon the wires, in combination with the two arms of a Wh atstone bridge.

528,286. GALVANIC BATTERY; M. M. Clark, Chicago, Ill. Application filed May 27, 1893. The combination with the negative electrode having notches, of plates, and of insulating material, a sack having its ends secured respectively to the plates, and a solid depolarizer contained in the sack.

528,291. UNDERGROUND CONDUIT; J. F. Cummings, Detroit, Mich. Application filed January 16, 1894. The combination of a casing, apertured blocks at the end of the casing, ducts supported at opposite ends in the apertures of the blocks, and having extensions projecting beyond the blocks and the opposite ends being correspondingly retracted from the end.

528,301. ART OF COATING ELECTRIC CONDUCTORS; A. F. Montgomery, Lincoln, R. I. Application filed July 2, 1894 This consists in moving a covered conductor lengthwise through a vacuum chamber and through a liquid partly filling that chamber.

528,330. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; J. B. Linn, Cleveland, O. Application filed December 9, 1893. A slot rail formed of beams having a groove therein, a conductor in the bottom of the groove, and a channel iron in the top of the groove, and contacting boxes arranged between the beams, and also provided with grooves to form a continuation of the grooved slot rail.

528,345. TELEGRAPH KEY; C. F. Sebring, Leeds, Mo. Application filed July 2, 1894. This comprises a pivoted key-lever, electrically connected to one wire of the line, and provided with a contact pin, and a contact plate located below and out of contact with the contact pin, and electrically connected to the other wire of the line, a plate electrically connected through the base plates of the key and other connections to the lever, a lever pivotally supported by an arm of the plate and provided with a contact pin and a spring connected to the lever, and holding the contact pin yieldingly into engagement with the contact plate of the pivoted lever.

528,379. CLOSED CONDUIT ELECTRIC RAILWAY; J. F. McLaughlin, Philadelphia, Pa. Application filed May 10, 1894. This comprises a main conductor and a sectional working conductor in the conduit, and exposed sections seated in the top of the conduit and electrically connected to the sections of the conduit, and magnetically operated switches pivoted to the main conductor, formed with switch plates in operative relation to the underground sections of the working conductor and with armatures close to the top of the conduit.

528,430. ELECTRO-MAGNETIC SWITCH; J. G. Hartel, deceased, Keokuk, Ia. Application filed December 2, 1893. The combination of a spring actuated switch lever in the circuit of a motor, a spring catch for holding the switch lever against a contact, a pivoted lever connected with the catch and a weight normally held detachably on an arm of the lever, an armature and flexible connections between it and the pivoted lever.

528,440. REVERSING MECHANISM FOR ELECTRIC MOTORS; J. Mellen, Newport, Ky., and N. O. Goldsmith, Cincinnati, O. Application filed March 24, 1894. This comprises reversers and their terminals, and two alternate circuit connections with the motors, and cut-outs operated alternately by the transmitting mechanism of the motor to automatically cut-out its circuit.

528,444. ELECTRIC SIGNALLING APPARATUS FOR BLOCK SYSTEMS; M. S. Reilley, Washington, D. C. Application filed June 13, 1894. The combination with a semaphore arm, of a rock shaft having a lever connected thereto and provided with two or more armature-bearing arms, one of which is rigid on the shaft and the other loose, the latter having a segmental slot to receive a pin projecting from the surface of the rock-shaft, and two electro-magnets adapted to attract the armatures on the arms.

528,445. SECONDARY BATTERY; J. E. Rhetts, Salem, Ind. Application filed November 22, 1893. A series of negative and positive electrodes each consisting of a flattened leaden receptacle having ends and bottom closed and its side walls perforated, the alternate members of the series being provided at opposite ends with integral lugs projecting from their upper ends and forming two series of binding posts, the central lugs of each series being provided with two bolt holes and the remaining lugs of the respective series being bent inward laterally and bolted to the central lugs by bolts passed through the lower bolt holes.

528,465. ELECTRIC MACHINE FOR RAILWAY SYSTEMS; E. Deming, New York, N. Y. Application filed May 27, 1893. This comprises a vertically movable trip located in the path of the wheel, a vertically moving bar in the path of the trip, an electric switch carried by the bar, a spring bearing against the bar and resisting its action, a pivoted catch for engaging and retaining the bar in its lowest position, and a magnet whose armature is in the path of the catch.

528,477. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; C. H. Harkins, St. Louis, Mo. Application filed December 9, 1893. In an electric railway independent switches located at intervals along the track, each comprising a housing having a flexible portion, a pair of contact points located within the housing and projecting between the contact points so as to vibrate to one or the other and to stand out of contact with either of the contact points so as to vibrate to one or the other, and to stand out of contact with either of the points when the switch is at rest, and a brush secured to and carried by the flexible portion of the housing and adapted to be engaged by a plate on the moving car to vibrate the arm and bring it into contact with either of the points.

528,494. CLOSED CONDUIT FOR ELECTRICAL RAILWAYS; Wm. F. Stearns, Berlin, Conn. Application filed April 7, 1894. In an electrical railway system, the combination of a compressible insulating envelope, an electric conductor mounted therein, a series of contact strips carried by said envelope, a traveling trolley plate having a downwardly extending offset portion for shedding water and a series of trolley wheels journaled on fixed arbors carried by said trolley plate and mounted to have free lateral movement.

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CONTENTS.

ALTERNATING CURRENT ARCS.

Although the subject of the relative efficiency of the alternating and the continuous current arc has already been well threshed, some results just published obtained by Dr. Fleming some years ago, may still be of interest. In a paper abstracted in the Digest this week he showed from experiments that for the same number of watts in the arc the spherical candle-power of the continuous current arc is to that of the alternating current arc as 3 to 2, but that if the quantity of light directly available for lighting a floor space be taken into account, then the efficiencies are in the ratio of 6 to 2. This is of course only one factor in determining the relative commercial values of the two lights, and it loses most of its importance in the case of parallel distribution so common abroad, in which the continuous current arcs must have a dead resistance in series with them absorbing as high as 30 per cent. of the energy, while for alternating arcs the voltage is transformed down to that required by the lamp. But that the matter is of importance is shown by the fact that in England rectifiers are becoming more and more prominent when arc lights are run from alternating current circuits. While in many cases it may be an advantage to supply an arc light from incandescent light mains, as a rule we think the American practice of running arc lights in series on separate arc light circuits, is the best, at least for street lighting, and when the lights burn for a certain definite period and are not scattered too much.

THE INCANDESCENT LAMP PATENT.

On November 17 the Canadian Edison Incandescent lamp patent expires and simultaneously the United States patent on the same invention comes to an end, its life being limited by that of the former patent through having been issued in Canada prior to the date of the United States issue. There is, it is true, a chance that its life may be revived in this country by a reversal of the present law in the Bate Refrigerator case, argued before the United States Supreme Court this week, but such an eventuality is pronounced by those well qualified to express an opinion on the subject as extremely improbable. Should such a reversal, however, be made, the patent, of course, during the intervening period is nul, and the art free to all. It would not seem possible that anyone manufacturing during that period could thereby be subjected to any claim for an accounting of profits, though he might be compelled to cease manufacturing after the decision, and even this, in view of the past history of patent litigation, cannot be too confidently asserted. There will doubtless occur to many in connection with the expiration of the incandescent lamp patent, reflections in regard to the uncertainty of the protection afforded by our patent laws. Though one of the most important inventions ever made, and notwithstanding the support eventually accorded by the courts and an annual demand for the commodity manufactured under it, which, before the date of expiration, had entered the millions, it is nevertheless true that little if any money has been made from the lamp patent, while much has been lost by investors through a misplaced faith in our much-lauded, though eminently uncertain, patent system.

THE RECENT ELECTIONS.

We print elsewhere in this issue the views of a large number of business men connected with the electrical and allied trades in regard to the business effect of the recent elections. As will be seen, the concensus of opinon is that the result will lead to an early amelioration of business conditions, with a probability of the good effect extending over several years at least. While political faith is doubtless a factor in some of the opinions expressed, yet there must be a basis of fact to account for the substantial unanimity of opinion held, for business men as a rule are too hard headed to

let their political beliefs run away with their business judgment. That the tariff question, though not directly at issue, was a large factor in some localities, is undoubted. Aside from this, however, was the intense dissatisfaction at the manner in which the business interests of the entire country were kept in suspense for months while the Senate was squabbling over the silver and tariff bills. It is but natural that the deplorable tactics of delay then pursued, regardless of the destructive effect of this delay on the business interests of the entire country, should have exasperated even the stoutest of partisans, and when with this was coupled the suspicion that corrupt motives were also involved, it is not at all surprising that there should follow such an overwhelming rebuke as that just administered. With those driven from power who had to bear the responsibility for this state of affairs, and with the party which has succeeded in no position, for several years, at least, to reopen the questions which produced such demoralization, there is every assurance that we shall now enjoy the stable conditions so necessary to commercial prosperity. Nothing is to be so sincerely regretted as the demoralizing effect which partisan or corrupt politics may have on the business interests of the country, and it is to be hoped that the severe chastisement of November 6th will have a beneficial effect for years to come.

COLD LIGHT.

In connection with Prof. Ebert's recent paper, which, since we called attention to it, has been published in many other electrical journals,—we remarked editorially in our issue of October 6th, that the light efficiency of an incandescent lamp was stated by others to be about 5 per cent. "from which it would appear that the greatest possible efficiency that can be expected is twenty times as great as that of the incandescent lamp, assuming that the 5 per cent. which is now converted into light, is converted as efficiently as it is in the cold phosphorescent lights." Our intention in making this remark was to call attention to an apparent discrepancy between this usually accepted statement and the enormously greater efficiency which Ebert claims is possible. He claims to have obtained about one-fortieth of a candle from one-millionth of a watt, or at the rate of one candle for one twenty-five thousandths of a watt, which is about seventy-five thousand times the watt efficiency of the present incandescent lamp. The idea that a central station would be able to supply 75,000 lamps in place of every one lamp at present, with the same quantity of coal, is certainly very startling and seems almost incredible. It follows from this, that either the supposed 5 per cent. efficiency of our present lamp is wrong or else Prof. Ebert is mistaken, or probably both. Dr. Bell, in a communication to us, assumes that the 5 per cent. is correct and concludes that "either Ebert's figures are enormously wrong or else his light is derived, not from the transformation of electrical energy, but from the potential energy of the luminescent substance, in which case the apparatus becomes a species of modified candle instead of an electric lamp." His conclusions would seem to be correct provided his assumption is not wrong, but is it beyond dispute that the light efficiency of an incandescent lamp is as high as 5 per cent.? Such high authorities as Tesla, and we believe Prof. Langley, also, have made statements that show that this 5 per cent. is far too high. The energy converted into light in an incandescent lamp was measured, we believe, by the difference between two nearly equal quantities, but every physicist and chemist will doubtless agree with us that such a method of measurement is the worst possible and is used only when there is no other way. With all due respect to those who have measured the light efficiency of the incandescent lamp, the results are so contrary to statements made by such authorities as Tesla, Ebert, Langley and others, that they cannot be accepted. We trust that this, which forms a part of one of the two most important problems of the present day, will receive the attention of the highest authorities and be fully discussed. We will be only too glad to give space in our columns to any one who can contribute any knowledge to this most important subject.

PHOTOMETRIC SYMBOLS.

As our readers well know, we have taken an active part—more so than any other journal, except perhaps L'Industrie Electrique—in endeavoring to introduce the much needed uniformity in electrical symbols, terms and definitions. Several years ago, when the American Institute's Congress proposals were discussed, we published a very complete report of the criticisms made abroad. Besides publishing Hospitalier's excellent table, both as originally proposed and as subsequently revised, we have also given reports of all discussions of terms and symbols which have been proposed since the meeting of the Congress. Among the latter there were besides the term reactance, a much needed set of photometric units, proposed by Prof. Blondel, a full report of which was published in the Digest and discussed editorially. Judging from the fact that his proposals, with one exception, have not brought forth any adverse criticisms, and as they have been published for some time, it may now be safely assumed that they are generally accepted. Probably there will be some chronic late comers, as there were in the case of the Congress proposals, who wait until it is too late and then come forth with objections against what the majority have accepted, but as they have not taken the trouble to give their opinions when asked to do so, their criticisms and suggestions need not be considered. In this we refer to the classification and the terms of the photometric quantities. The subject of the names, the values of the units and the symbols of the quantities, are still open for discussion. Mr. Hospitalier, that ardent, clear-minded and indefatigable advocate of a uniform system of units, terms and symbols, has just suggested a set of symbols for these photometric quantities. They are given in the Digest this week and consist of the initial letters of the French terms, represented by bold-faced type, such as was formerly used for some of the magnetic units. By chance these initial letters are all different in the French language, while in the English and German most of them are L and many I. While he expresses himself as quite willing to have chosen the initial letters from other languages, he gives this as a reason for not doing so. It seems to us that the argument is a good one and as we can see no objection to his proposals, we are willing to advocate these symbols and introduce them into our columns, unless in the discussion which we hope will follow, sufficiently good reasons are given to change our present opinion. An examination will show that these initial letters represent the initials of the English terms as well as the French, if we take the principal word in the term, that is, the noun, and in one case "quantity of light" **Q** instead of **L**, which already represents "lumination." There is only one exception to this, the **E** (eclairement) for "illumination." While this single exception is an unfortunate one, especially as it is an important quantity, yet it will be no more than due reciprocity to accept it, as the French have changed another term to suit English speaking people. One fortunate feature in his proposals is that these letters do not include either **B** or **H** and it therefore cannot be argued that they may be confused with the now obsolete symbols for these well-known magnetic units, for which the last Congress has recommended the French script letters, which recommendation is being generally accepted, except by some English writers and journals who still resist the introduction of international uniformity, as they have and do in the case of their wretched system of weights and measures, which we Americans have unfortunately inherited from them. We trust that those of our readers who are interested in these symbols will discuss the matter now or forever after hold their peace.

The Bate Refrigerator Case.

The briefs have been filed in the United States Supreme Court on both sides of the Bate Refrigerator case, and it now awaits argument. When last called for hearing Justice White was absent, and, owing to the importance of the case, the court decided to postpone the hearing until the entire bench is present. Nov. 12 was agreed upon by the Court and Council, but the case may not be reached until Nov. 14.

A General Theory of the Incandescent Lamp.

The last two numbers of the "Physical Review" contain a translation by Prof. E. L. Nichols of a valuable paper by Prof. H. S. Weber, read before the Frankfort Congress for Elektrotechnics, which gives a general mathematical theory of the incandescent lamp.

It is stated that the simplicity of the conditions existing in the production of light from the incandescent lamp are such as to lead to the supposition that between the size and temperature of the radiating surface, the wave length and intensity of radiation and the quantities by means of which the electrical energy developed in the filament are determined, there exist relations which are capable of expression in some simple form. Former investigations are criticized for the reason that the most important element—temperature of the filament—was left altogether out of account, and it was to the determination of this that Prof. Weber first applied himself, making for this purpose exact measurements upon more than 30 types of lamps. He states that he believes he has now reached a point where the phenomena of incandescent lamps may be expressed by means of a few formulæ.

The starting point of the investigation was the establishment of a general expression by means of which the intensity of homogenous radiations of a given wave length emitted by a solid body at a given temperature might be expressed in terms of wave length and temperature, and of the size and nature of the radiating surface.

A formula for this purpose was deduced, by means of which the temperature of the filament could be determined, provided a certain constant were known, which was determined for 33 different filaments belonging to two groups. Three of these filaments were black and the other 30 showed gray surfaces, and the mean value of the constant for the two groups was as 100 to 75, which is almost exactly the same relation which Leslie, at the beginning of the century, found for lampblack and graphite. It may therefore be asserted that incandescent lamp filaments with gray surfaces should be classed as graphitic carbon.

A very surprising result derived from the formula is that the normal temperature of the filament of all sorts of lamps is very nearly the same and is included in an interval between 1,565 and 1,580 degrees on the absolute centigrade scale. In the case of some lamps of very great brilliancy, that is to say, of lamps having thick filaments, which can be brought to higher temperatures without serious damage and which can consequently be operated at a higher economy, the normal temperature is about 40 degrees higher.

It is also necessary to know between what temperatures the filament changes when the candle power is varied through a considerable range from 2 to 30-cp for example in the case of a 16-cp lamp, or from 20 to 300-cp in the case of a 200-cp lamp; the result of measurements show that the temperature variations which correspond to such changes in brightness amount to about 180 degrees. In practice, accordingly, incandescent lamp illumination covers a range extending from 1,400 to 1,600 degrees C. for small lamps, and 1,450 to 1,650 degrees C. for large lamps. Applying these considerations to the formula, the simple law is deduced that every increase in the energy of a current amounting to one-half per cent. raises the stationary temperature of the incandescent lamp one degree centigrade.

The definitive quantity in the case of the incandescent lamp is the energy which the electric current develops in a filament in a unit of time; by means of this the temperature of a filament is determined when the surface is known, and thus finally the quantity of light which the filament radiates is given. One of the fundamental questions in the domain of incandescent lamp illumination is the relation between the amount of light radiated and the amount of energy necessary to its production. Prof. Weber found that the formula

$$\text{Candle Power} = KW^3 \quad . . . . \quad . (1)$$

where W is the energy in watts and K a constant, is fairly well established. It appears, however, that the value of the co-efficient K is not quite a constant, but that it increases as the light increases from small intensities and then more rapidly with increasing brightness to a maximum, and finally diminishes again. For different lamps, however, the value of the co-efficient varies enormously—from 1.49×10^{-6} in the case of the 'Sunbeam" lamp to 70.4×10^{-6} in the case of an Allgemeine Electricitats Gesellschaft lamp.

From equations previously established Prof. Weber deduces the following formula, which applies to all lamps; the candle power refers to the mean spherical value expressed in British candles; K is the constant of the lamp, S the surface of the filament in in cm² and W the energy applied to the filament:

$$\text{Candle power} = \frac{6.8 \times 10^{-15}}{KS^2} W^3 \quad . . . (2)$$

From this formula Prof. Weber points out that the dimensions of a carbon filament to give a certain intensity of light under certain conditions can be calculated.

An important deduction made from the formulæ developed is that within a practical range a rise of n degrees in temperature will improve the economy of light production by nearly n per cent.

One of the important results of the investigation has a direct bearing upon the question recently raised as to the optical efficiency of the incandescent lamp. Prof. Weber finds that at normal temperatures of incandescent lamps their optical efficiency is in the neighborhood of one per cent. He refers to experimental determinations which give from four to five per cent. efficiency, but states that these were dependent upon an assumption that an aqueous solution of alum absorbs all the dark rays and lets through all the visible rays, which is not quite true, and a correction shows that these experimental results may be reduced to as low as three per cent. by applying corrections.

Prof. Weber states that it has long been known that the rapid diminution in the life of incandescent lamps with rising economy is to be explained by the fact that the carbon at a certain temperature begins to show notable vaporization, which with a further rise of temperature increases in intensity. A method is shown by means of which the point can be approximately determined at which the carbon begins to show evaporation, and where, therefore, this deterioration begins. This is variable with different lamps; with a Woodhouse lamp it was found to be about 1,610 degrees C. and with an Allgemeine lamp, 1,603 degrees C.

Electric Conduit Railways.

At the regular monthly meeting of the New York Electrical Society on November 1st, Mr. Joseph Sachs read an interesting paper entitled "Is There a Solution of the Electrical Conduit Railway Problem?"

Mr. Sachs gives as reasons why success has not been attained with electrical conduit railways thus far, that most of the projects were immature, the inherent difficulties are great and the cost of construction very large; on the other hand he thinks that the maintenance would seem to be less expensive than with the trolley.

After describing a large number of conduit systems, Mr. Sachs said that there was not much of a choice between them, as there had apparently been nothing practical evolved from the extremely large number described, except the plain open slot conduit and continuous wire system. This is the one that is in actual operation and has given satisfaction both at Budapest and at Blackpool, England, but he considered it doubtful whether it can be made practicable in this country, where the climatic and local conditions are different.

Mr. Sachs gives it as his opinion that we will never get a conduit system which can put in for $20,000 a mile, single track, and that it may be as high as $30,000 or $40,000 per mile, single track.

The system which is to be installed upon Lenox avenue by the Metropolitan Traction Company was then described; a section of the conduit is shown in the accompanying cut.

The ordinary conduit yoke will be employed and at the main holes, 30 feet apart, the insulators, which are of rectangular form and of soapstone, will be located, and supported in cups embedded in sulphur. At the top of the insulators is fastened an arm of iron. To this arm is fastened a contact conductor of channel iron. The contact shoe comes down to the slot and has two arms which press outwardly from the single supporting bar which rests on the rails, making a continuous rubbing contact. There being two conductors used there is no structural return.

As will be seen from the cut, the insulators are located in the manholes and are easily accessible. They are quite a distance apart and the voltage is low, it being intended to use about 250 or 300 volts. The conductors are very nearly directly under the slot, which was apparently the objection in some of the first systems, but the peculiar construction and location of the insulators in this system may prevent any trouble from this source.

An extended discussion followed the reading of the paper. Mr. C. B Fairchild thought that it was a question whether there is any extraordinary demand for an underground electric system, and he quoted from an authority who stated that "a successful underground system would be a great calamity for the street railway interests of this country, from the fact that if one were adopted every little city throughout the country would demand that all the

wires be put unnderground, and it would ruin nine-tenths of the street railways of this country if they were compelled to operate under such a system." He described the underground system which is now being placed in Washington, D. C. The yoke is about the same as has been used in Washington on the cable construction, a little heavier, perhaps, and the conduit is about 25 inches deep and 18 inches wide; the conductor is a four-inch channel iron, four inches deep, and supported from the top instead of the bottom as will be the case in New York City, and headed with trurnion bands to provide for expansion. The cost is estimated to be more than the cost of cable construction, and Mr. Fairchild states that the Siemens Halske Company, who proposed at one time to put in an underground system, admitted to him that the cost would be more than the ordinary estimates for cable construction. In New York City, the cable roads were built for not less than $150,000 per mile single track, but in Washington the cost is about $30,000 per mile, of single track; ordinarily, however, the cost would be from $60,000 to $75,000 per mile with single track.

The difficulty of contraction and expansion in conduit conductors was referred to, and Mr. Fairchild stated that in Washington, where the temperature in the conduit varied from below freezing to 140 degrees, a great deal of difficulty had been experienced- in this connection. Mr. Fairchild fears that there will be difficulty in the Washington system through using a porcelain insulator, as he thinks it will require a material less hygroscopic, such as mica or something of that kind. He referred to the extreme dampness of conduits and thought that an economical street railway cannot run with a 300-volt current, at least 500 volts being required. A heavier construction will also be required to support electric cars than required for cable cars, on account of the motors, and the cost will be correspondingly great.

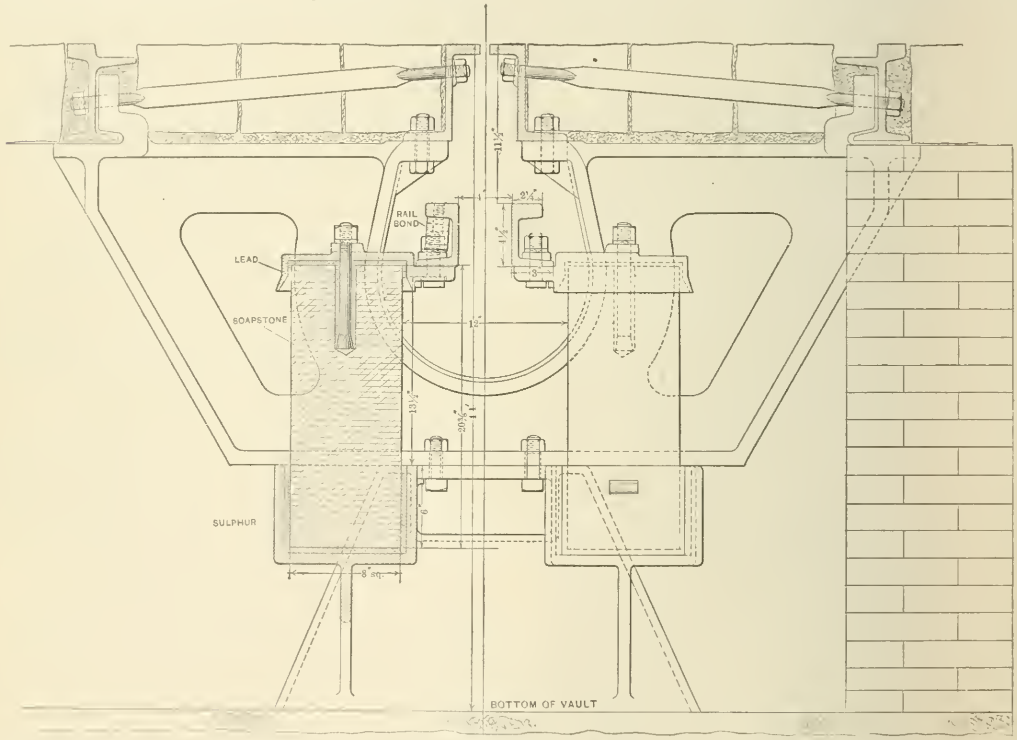
Electric traction is very much harder on the rails than cable traction where the headway is under three minutes. Even where the rail is from 75 to 80 pounds, the cost of maintaining the track where electric cars are used is surprisingly great. In answer to a question as to the comparative cost of the cable and electric roads, Mr. Fairchild stated that the cars in both cases would cost about the same but that the motor would cost from 10 to 12 times as much as the grips, or a difference of about $1,000 per car.

Mr. R. R. Lundell stated in regard to the Johnson-Lundell system which is now being tried at 59th street, that the storage battery used is a very small one but it carries the car through emergencies and will bring it back to the station in case of a breakdown. Through its use expensive electric conduit construction is done away with, also complications such as switches and cross-overs. Mr. Lundell gives as reasons for the adoption of this system that in New York City the open slot, owing to the size of the conduit, would necessarily be very expensive. The Johnson-Lundell system, he said, could consequently be installed much cheaper. The electro-magnetic device was adopted, as the electromagnet has shown itself to be positive. He stated that they are now ready to put down the system at $30,000 per car mile double track for the electrical equipment without rails or ties, and Mr. Sachs added that the track would cost about $20,000 a mile additional. The battery weighs only 1,500 pounds and takes care of itself; it is always sealed up and charged continously. The voltage is 300.

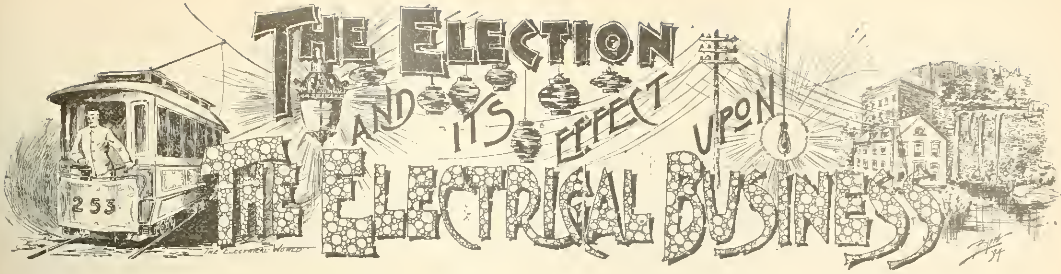
Mr. Field stated that in the case of one road which he put down, the cost of the trolley system was as high as $75,000 per mile for a single track, which included $20,000 per mile for paving the streets from curb to curb. He stated that the Budapest system, as modified in America, would fill all the requirements of American conditions. He said that the conduit which is going to be put in in New York City is a modification of the Siemens-Halske conduit.

Mr. E. A. Merrill described the three-wire system with which, he said, there was difficulty in balancing. At Bangor, Me., in going up steep hills, very frequently they would have to take the trolley off one side and put it on the other wire. The same difficulty in balancing was found in Milwaukee. He stated that he knew of one road where the cause of the difficulty was not discovered but the road was abandoned. He referred to the much greater investment in copper at 300 volts, which would be four times greater than at 600 volts, and said that it was not a very large road that puts in an investment of $100,000 to $150,000 in copper, so that at a reduced voltage it can be seen what the difference would amount to.

Mr. Fairchild questioned a statement to the effect that electric and cable roads in certain conditions were operated at about the same cost per car mile, as he had found that cable roads as a general thing, under the same conditions, are cheaper than electric roads.



ELECTRIC CONDUIT OF LENOX AVENUE RAILWAY.



In order to furnish to its readers an indication of the sentiment prevailing among those connected with the electrical and allied business interests as to the probable effect of the recent elections, The Electrical World has made a canvass of the leading men connected with these particular branches of trade, and gives herewith their views on the subject. As those who speak are well qualified to judge of the situation, and as they voice the opinion of many localities, what they say will, we believe, be found of much interest. It will be noted that they are almost unanimously of the opinion, though no economic question was directly at issue, that the effect of the election will be exceedingly beneficial to the electrical industry as well as to others by settling for a term of years the recent disturbed business conditions.

Elbert Wheeler, treasurer Wheeler Reflector Company, Boston:—"We confidently expect immediate and gradually increasing response by the business world, because of the settlement of political matters. We firmly believe that as the atmosphere has so cleared itself, the outlook for the future is exceedingly bright."

A. A. Zeigler, president and general manager Zeigler Electric Company, Boston: "With the Republicans enjoying their large majority, and a considerable number of the people satisfied with a moderate tariff, everybody outside of a few grumblers appears to be content, and why should there not be encouragement for new enterprises?"

Norman Marshall, president Iona Manufacturing Company and vice-president Anchor Electric Company, Boston: "Manufacturers generally will now know just what they can depend on for five or ten years to come, and dealers will not hesitate to stock up, so that the present gratifying activity in our particular lines of business we look to see continued for a considerable time to come."

D. A. Andrews, Jr., vice-president and treasurer of the Pettingell-Andrews Company, Boston: "Apart from any political views I may have, my opinion of the election is that we shall have an increased volume of trade and better feeling. My reason for this is that everything points to Republican rule for some years in both local and national politics, and this will give a more settled feeling than could be if the vote had been closer or less pronounced. Settled politics is what we want and not change, whichever party is in power."

Frederick Fosdick, president Fitchburg Steam Engine Company, Fitchburg, Mass.: "The forecast in the opinion of mine published in the Electrical World of September 1st has been fully realized. 'Mongrel Tariff bill passed;' reduction in wages and strikes everywhere, and consequently a 'reduction in purchasing capacity.' The tremendous overturn by the recent election shows conclusively that the people intend to stop 'blood-letting' from the national heart by tariff tinkering, and in my opinion confidence in the future will be at once restored. To be sure, purchasing capacity is less, but general stocks of merchandise are very low and a moderately increased demand, which there is sure to be, will give a healthy tone to business, and I look for a large increase by spring. The country has been going hungry for nearly two years, and with return of confidence will take steps to partially, at least, satisfy its hunger. I can see no chance for immediate increase of wages under the competition the present tariff bill has brought. The electrical industry has suffered less than most, I believe, but with return of active manufacturing and confidence of investors this business must receive a large increase. The strength of the expression of the popular will is such that I look for five to eight years of great prosperity, on a sound basis."

W. E. Sessions, manager Sessions Foundry Company, Bristol, Conn: "I believe that the effect of the elections on business in general will be very beneficial indeed; and although I do not look for a boom right away, still I anticipate a decided improvement and general resumption in all lines of business."

R. F. Blodgett, secretary of the Pratt & Whitney Company, Hartford, Conn.: "The elections give overwhelming evidence of the dissatisfaction of the people of the United States with the recent tariff legislation and their decision to bring about a change as quickly as possible to a condition of protection to farmer, laborer and manufacturer. The desire for sound money and honest administration of municipal affairs was also strongly emphasized, and the result will be a restoration of confidence, revival of business in all lines except those that have been temporarily 'knocked out' and the starting of new enterprises."

Z. Chaffee, president, Builders Iron Foundry, Providence, R. I. "The effect will be beneficial. Several of the municipal and state elections are victories for those desiring honest government, which does much to create confidence in the business world. Probably the majority of business men are also pleased that the Republican party will return to power in Congress, but any immediate efforts to again unsettle the tariff would be prejudicial."

H. N. Fenner, treasurer, New England Butt Company, Providence, R. I.: "I should depreciate any undue impulse to the business of the country as a result of the recent Republican tidal wave. We do not want a boom but a slow and healthy growth that will be lasting. If the result is a guarantee of no tariff agitation and sound currancy legislation, then there is a basis of confidence, and confidence is all that is required to bring back our former prosperity. Renewal of commercial prosperity means the renewal of activity in the electrical industry, for it is as much a part of the commercial industry of the world as any business interest."

T. J. Smith, Esq., manager of The E. S. Greeley & Company, New York: "The patient will immediately begin to acquire strength and an uninterrupted progress toward complete recovery may be confidently expected."

Charles P. Geddes, secretary and treasurer of the Interior Conduit and Insulation Company, New York: "Our company is doing better to-day than it ever did, and everything looks favorable for a prosperous winter in the electrical industries.'

James L. Robertson, president Hine & Robertson Company, New York: "I consider the results simply GRAND, and that they will do more to restore business to its normal condition—at an early day—than could have been done through any other means."

W. P. Jones, secretary Law Battery Company, New York: "Personally speaking, we experienced a revival of business before election; therefore, if the outcome of the balloting is to be beneficial it will be with us a case of large favors thankfully received."

W. H. Leitch, of Abendroth & Root Manufacturing Company, New York: "It is rather early to prognosticate, but the result must prove beneficial. Electric light plants and trolley road power houses have given us plenty of boiler work for several months, and there is now a pronouncedly better feeling."

George L. Colgate, New York: "On general principles politics has nothing to do with business. The recent election assures a restoration of confidence. Supply and demand will do the rest. We are entering an era of prosperity which has the prospect of permanency, such prosperity as this country is capable of and Americans are able to appreciate."

J. H. Vail, president Electrical and Mechanical Engineering and Trading Company, New York: "I consider the result of the elections of November 6th as largely tending toward a settlement of the disturbed business conditions of the country that have ex-

isted for the past two years, and I fully expect to see the electrical and kindred industries make marked advances at an early date."

Walter C. Kerr, of Westinghouse, Church, Kerr & Company, New York: "Our business this fall has been characterized by fickleness. We have had our hopes raised at one time by orders and inquiries, when shortly afterwards the bottom would seem to drop out of trade. Now that the election is over, however, I look for steadier times, but do not think we will have more than a moderate winter trade."

F. A. M. Burrell, of Charles A. Schieren & Co., New York: "We have had a good fall business, and I am confident dull days have left us. Though the productive powers of this country have rather exceeded the consumption for some time, I think the natural growth of the United States and extension of foreign trade will before long eliminate over production for many years."

H. C. Adams, president of the Phillips Insulated Wire Company, New York: "The results of the election must restore confidence all around, and business should soon be mending for the better. Tariff changes make no difference to us; business has been as fair before the recent changes as after, but the knowledge of a certain basis to work upon makes the conduct of future business more certain and more fruitful of results."

H. J. Gorke, manager Electric Engineering & Supply Company, Syracuse, N. Y.: "Regardless of all party feeling or political preferences I look with a great deal of encouragement for positive and favorable results in all lines of business, as the effect of the recent election will have a strong tendency toward establishing stability and confidence in both the manufacturer and buyer. At present our business is far ahead of our anticipations."

C. B. Miller, of the Magnolia Metal Company, New York: "In restoring a feeling of confidence that has been lacking, the outcome of the elections will prove a source of much gratification. The assured end to tinkering with the currency and the tariff lifts a load off the minds of the business men of the land. They are now in a position to gauge ordinary conditions and will again begin to assume the legitimate risks that belong to true business development."

An executive officer of the General Electric Company, New York, who did not wish to be quoted personally: "I think the settlement of the political strife will have a satisfactory effect upon all industries. There is no probability of an immediate boom, for it will take us some time to reach the pinnacle we came down from. However, the General Electric Company is doing well and all of the electrical industries are bound to be benefited by settled trade conditions."

George J. Jackson, general manager Norwich Insulated Wire Company, New York: "The requirements of feed wire for trolley roads is such as to make big demands for underground insulated wire. We have two extensive orders at Boston and Chicago to fill, and to complete all of our contracts on time we have had to run our factory day and night. Naturally we are satisfied with things, and as to the election I cannot see but that every industry will be benefited by the result."

Capt. Willard L. Candee, manager of the Okonite Company, New York: "Everything, comparatively speaking, has been dead for two years, but as people have now used up all of their tide-over supplies I believe prosperity is upon us. I do not look upon the settlement of the political issues as a harbinger of good times any more than in the attention given to politics instead of to business for the time being. We have orders enough to keep us busy, and look for a continued active fall and lively spring trade."

The Partrick & Carter Company, Philadelphia: "The results of the late elections can have only a beneficial effect upon the business interests of the country. The people (irrespective of party affiliation) were tired of tariff tinkering and threats of further changes, and they voted for a Republican majority in the lower House of Congress, which insures a rest from tariff agitation. Business everywhere ought to experience a revival from now on, and 1895 should bring a return of prosperity to all commercial, manufacturing and financial interests."

A. Mitchell Hall, general manager of the C. & C. Electric Company, New York: "The business world of America, including both employers and employed, has expressed most decisively its wish that further legislative agitation shall be stopped, and that business be allowed to resume its normal condition. I feel that the electrical business in particular has a very bright outlook, and that the [illegible]ival of confidence will shortly be felt in the large increase of electric transmission as a means of economizing in cost of manufacture in isolated plants, and in transmitting power long distances."

Thomas C. Wood, president the Ball & Wood Company, New York: "Whatever affects the commercial must affect the electrical interests of the country, and the result of Tuesday's election will re-assure business men of both political parties, since it seems to promise conservative legislation in Washington for some time to come. To New York business men who want public affairs administered on a clean and honest basis, the situation is full of encouragement and hope, for the moral influence of the election will be felt not only in the City Hall, but in every counting room and workshop in the city."

Ralph L. Shainwald, president of the Standard Paint Company, New York: "Anything that tends to make the operations of general business more stable is certainly an advantage. That the result of last weeks elections has this tendency is unquestionable. The electrical industries being among the most active of our present system, will, it seems to me, be among the very first to benefit by a better regulated order of things. We found that these industries especially began to grow active immediately after the panic, and with the even better outlook that is now discernible I believe they will be very active from this time forward."

R. E. Gallagher, secretary of the New York Insulated Wire Company, New York: "We do not anticipate any change, except for the better. The demand for our wire this fall has been sufficient to keep us busy, and now with politics aside people will give more attention to business. There is no danger of more tariff tinkering for several years, which is something to be thankful for. We can not expect general trade revival so long as there is such an enormous amount of money tied up in the banks. This is the keynote to the situation and when that begins to move we may all feel assured that prosperous times have come to stay.

Frank M. Pierce, president of the Pierce & Miller Engineering Company, New York: "I cannot see why the effect of the recent elections on the industrial interests of the country should not be wholly good, as it settles the question of tariff tinkering until the end of Mr. Cleveland's administration at least, for neither party will have sufficiently strong control in the national legislation to carry out their opposite ideas regarding the tariff. This enables business men to look ahead and plan with certainty, thus restoring confidence, and letting loose the capital which is now lying idle owing to lack of confidence. The electrical industries offering a good, safe and profitable investment for capital, will undoubtedly be greatly benefited."

Charles D. Shain, New York, Eastern representative of the Siemens & Halske Company: "I can see no reason to change my former views expressed at the time of the tariff changes. I do not anticipate that the tariff will be again raised and believe that the conditions existing in this country to-day are so different from those existing years ago that a high tariff is neither necessary nor beneficial to the electrical interests. Unquestionably there was a time when tariff protection assisted largely in making this country the great one that it is, but in my opinion this has passed by and with free trade or something near to it the manufacturers of electrical apparatus in this country can compete in the markets of the world."

E. K. Conover, of the Conover Manufacturing Company, New York: "It is a matter of course that the electrical industry will be benefited by the outcome of the 1894 landslide. There has been enough business in sight all along, but it is not exaggerating a bit to estimate that nine-tenths of the orders in sight have been held up awaiting what the future, as affected by the economic policy of the victorious party, had to offer. These held up orders will now be released, and there should be an immediate rejuvenation of business. This applies not only to the electrical trade, but as the further introduction of electricity depends upon the progress of commerce in general, it and its allied trades will be in the front rank in any spread of activity."

Charles McLaughlin, of J. H. Bunnell & Co., New York: "The nullification of any tariff meddling by Congress by reason of the contrary political opinions of the President, will give to the business interests a sense of security sadly lacking of late. Congress with a Republican majority will certainly not pass any measure that Mr. Cleveland can approve, and it is equally as certain that it will not act in accordance with any suggestions that he may set forth in his annual message. Mr. Cleveland can also be depended upon to lend his approval only to sound financial measures, and this assurance is a great comfort to the business men of the country, who in recent years have had to contend with any number of un-

toward circumstances as a result of ill advised legislation. With us trade has been very good all along and promises to be even better."

James H. Seymour, president Clark Electric Company, New York: "Your method of obtaining the views of those connected with the electrical and kindred industries in relation to the business outlook for the future is wise. The causes of the severe business depression are both political and commercial, but these have now been mostly corrected; therefore, the future is promising. Never in the history of electricity has the industry been conducted on so sound a business basis as it is now. Business depression, while a severe experience, is valuable. The vote to authorize New York City to loan its credit to the extent of fifty millions for rapid transit is important, as electricity will be called upon to furnish the motive power, light and heat. No industry has so bright a future as electricity, and the press representing that industry has a wide field of usefulness."

Gen. E. S. Greeley of The E. S. Greeley & Company, New York: "It is too soon to be actually benefited by the election, but we are now more hopeful. I think any business man of whatever political opinions must feel better satisfied with the conclusion of political issues. One blessing is that there can be no detrimental legislation on silver or tariff. One of the surest ways to make hard times is to begin tinkering with these questions. The natural outcome of it is the hoarding of money and the paralyzing of industries. One of the hurtful things to the electrical industries was the abrogation of all reciprocity treaties. Since the new customs law has taken effect some of the South American countries have put heavy duties on American electrical apparatus and in some cases the duties have been made almost prohibitory, notably by Cuba. I trust that this will be changed. We now anticipate doing more business in our home markets."

Mr. A. L. Doremus, assistant to President S. S. Wheeler, of the Crocker-Wheeler Company, New York: "Of late we have been receiving a good many inquiries relative to factory installations. Any number of large companies throughout the manufacturing sections of the country are preparing to supersede their old steam plants with electric power, but they have held up their orders pending the election. I recently travelled through Connecticut, and while the many inquiries for estimates seemed to indicate that the Republican victory, with its assurance of unchanged tariff conditions, had been in some measure discounted, there were cases in which definite contracts were held off until there should be a certainty that business calculations would not further be upset by congressional interference. Trade in dynamos and motors has been only fair with us recently, but the clinching of many conditional contracts will greatly help to increase its volume."

J. J. Gorman, of the Manhattan Electrical Supply Company, New York: "I feel 50 per cent. more encouraged than even last September when the certainty that tariff agitation had ended—for the time being, any way—led one to hope that some trade revival was at hand. The dread, however, of the impending elections prevented much permanent improvement. For quite a period we have not taken in any long-time contracts. Engineering and supply houses have been unwilling to assume much risk. We have, moreover, supplied jobbers with little more than what their orders from their retailers called for—their orders to us being almost exact fac-similes of what their customers wanted for immediate use. This is now changed. We are already apprised of orders from jobbers for stock purposes. There are evidences of business ahead, and jobbers and supply houses are beginning to prepare for it. The revival in trade will not assume large proportions all of a sudden; it will, however, be steady and continued and that's the kind that counts."

James P. McQuade, secretary and treasurer of the National Conduit Manufacturing Company, New York: "I can give you the honest opinion of one of our directors, who has been a life long Democrat, and is to-day a leader in one of the Assembly districts of Tammany Hall, which is as follows: 'If the political landslide had occurred in New York City only, I would have thought it was a crusade against Tammany Hall, but it is the same thing all over the United States, even away down in Texas; it was my opinion the working people of the United States thought they wanted low tariff, but they have changed their minds and are unquestionably of the opinion that a protective tariff is the best thing for this country.' I, myself, look for a great boom in the electrical business following this election, as in our own immediate line there was one large contract that entirely depended upon the success of the Republican party, as the promoters of the enterprise did not feel like putting their money into a new scheme unless they were assured of a better feeling in the financial world, which wou[ld] enable them to dispose of their securities They felt that Wall stre[et] would be more in humor to take electrical securities if the Republicans were in power than it has been for the last two years."

S. F. Bagg, secretary Watertown Steam Engine Company, Watertown, N. Y.: "In so far as business has been held back and waiting until the election was over, we shall of course now see decidedly more activity. This I think is always the case with every election, regardless of the result. Aside from this, however, I do not believe the result of the election will affect business for good or evil. Of course a large majority of the business world undoubtedly feel more confident of a speedy revival, and this very confidence will in itself beget business. On the other hand, while the very sweeping Republican success will effectually prevent Democratic interference with the tariff for the next two years—it also suggests the strong possibility of another general revision at the end of that time should the Republicans elect a president and control Congress. Perhaps one consideration will offset the other. We are inclined to think that the force of the panic or depression has spent itself and that a gradual but sure resumption of business must come independently of the result of the election."

Carlton M. Williams, secretary and treasurer Morse, Williams & Co., Philadelphia: "Some one has remarked that the hardest things we have to bear in life are those that never happen. I think that while this country has such great resources that it can adjust itself in time to most all conditions. The constant tinkering with the tariff keeps business men in such a state of unrest that they have not confidence enough to make contracts excepting for immediate execution, and thus business is greatly retarded in all directions and kept in a very unsatisfactory state. The large Republican majority in the 54th Congress will prevent any further tampering with the tariff, and it being well known, and a generally admitted fact by even the Democrats of this section of the country, that the Republican party stands for sound financial legislation. I think if some arrangement could be effected by international agreement whereby the use of silver on a safe basis could be more generally established, we could look forward in this country to a season of great prosperity for a number of years to come. Of course we cannot expect to jump at once into that condition, but the growth of improvement would no doubt be appreciable in the near future and then we should go steadily forward in the right direction."

S. M. Hamill, general manager Brush Electric Company, Cleveland: "I believe that the fact of the Republicans being in control of the House and possibly the Senate, will have a most beneficial effect on the electrical business, as well as all business, for the reason that business men will be assured that there will be no further changes in the tariff for some time to come and certainly this in business is a great advantage. The electrical interests are so interwoven with other commercial interests that whatever benefits the latter will benefit the former. Recovery will, however, be gradual. It will take some time before we reach a period equal to the 'good old days' of 1891 and 1892; but I believe that the recent hard times have taught us all lessons which, if well learned and followed, will place our electrical business on firmer foundations and make advancement greater than ever before."

Chas. F. Thompson, manager of the Lane & Bodley Company, Cincinnati: "The future historian will ascribe the condition prevailing in the latter part of this century to the extraordinary development of metallurgy. It will be the Bessemer era, the triumph of engineering science in the mine, furnace and factory, the steady reduction of costs, the fierce struggle of manufacturers in competition. This will explain cheap silver, copper, iron and steel. He will chronicle the futile endeavors of politicians to maintain values by forced coinage, schemes of tariff and class legislation and the final acceptance of their failure by the people. He will recognize a repetition of the past, when similar great strides of progress were as reluctantly accepted, and will record that the American people accepted the lesson in 1894, started afresh, as it were, forgetting the past for the time, yet deeply impressed with what they had experienced. The electrical field will prosper; its newer branch, the transmission and conversion of power, will receive attention by every machine manufacturer. Lighting and transportation will gradually extend until every village has light and every county seat a street railway—not so rapidly as we would desire, perhaps, but a steady growth in volume and profits month by month."

J. E. Keelyn, president Western Telephone Construction Company, Chicago: "With liquidation largely accomplished and uncertainty now dispelled, the mother of invention will come forth

to great progress. As the first pickings of industrial genius are found in the electrical field, a good cupful is reasonably assured."

J. B. Wallace, manager Wallace Electric Company, Chicago: "The election was so uniform and the majorities so unprecendentedly large that the moral effect is very much the same as if it had been unanimous. In consequence of this the effect in restoring confidence and upon business will be considerable and immediate. Not only will general business be helped, but particularly the electrical interests. Being so new an industry it requires capital faster than it can at first be made out of the business, and general confidence is an important fact in obtaining such capital."

Geo. F. Stitch, vice president of the Western Telephone Construction Company, Chicago: "I opine, not as a partisan but as a business man, that the industrial condition of our country will now begin to improve. The overwhelming majority that was given for protection against free trade will certainly restore business confidence, and the moneys that are now locked in the safety deposit vaults and banks of the country will find their way into the different trades. Thus the circulating medium will be put to its proper use and from now on, I believe there will be a permanent improvement, not only in the electrical business, but in every business throughout the United States."

Thos. I. Stacy, secretary and treasurer Electric Appliance Company, Chicago: "It occurs to me that the very decisive nature of the recent Republican victory settles without doubt the result of the next Presidential election, and, therefore, determines the general political policy of the country for the next five or six years. Leaving out of the question entirely, therefore, the merits of high or low tariff, the simple fact of six years probable stability is, in itself, amply sufficient to fully overcome the already rapidly disappearing financial depression. We seem justified, therefore, in the assumption that business interests will experience a rapid revival, and when that revival is complete, we may, I think, expect the few years of exceptional prosperity for which we have been patiently waiting."

Lag Angle of Alternating Currents.

The question recently discussed in these columns as to what shall constitute the angle of lag in alternating circuits where the current is not harmonic was referred to in the discussion of Mr. Steinmetz's paper at Philadelphia by Dr. Bedell, whose remarks were as follows:

"There is one point to which a little further attention might be given, and that is in regard to the lag of the current behind the electromotive force when the current and electromotive force are not harmonic. Those who have had occasion to make a study of currents which are not strictly harmonic, and desire to find the phase relations, have doubtless met this question. The phase difference between the maximum values and zero values or any other values of the current and electromotive force, are not the same. The use of the equivalent sine function is the solution of this question. We assume an equivalent electromotive force which is harmonic and has the same mean square value as the electromotive force which is not harmonic, and we do the same with the current. We then set these two with such an angle of lag between them that the power is the same. Now we can get our power from other measurements and by these measurements of the power, the current and the electromotive force, we thus have a measure of the angle of lag in degrees which cannot be otherwise obtained when the currents are far from being harmonic. In other words, we say the power is $W = E\ I \cos \theta$. By measuring W, E and I, we may find a value for the angle θ, whether the current is harmonic or not.

Good Use of Poor Coal.

A poor quality of coal which is found in a certain mine in Germany, and which is too poor to be transported to any distance, is made use of by the erection of a large electro chemical factory next to the mines in which chlorine and soda are manufactured by an electrical process.

Nitric Acid from Air.

Dr. Froelich announces that a process has been discovered which admits of commercial application, for obtaining nitric acid from the nitrogen in the air by an electric process based on the action of ozone; the process is as yet a secret but a description of it will soon be published.

Notes on Recording Meters.

BY EUSTACE OXLEY.

Nothing is of more importance to electric light companies doing business on a meter basis, than to have their meters record correctly; and to insure their doing so, it is necessary that care be taken to observe certain conditions, as to where and how they should be installed. More especially is this the case with motor meters; and as my experience has been largely with meters of that kind, and particularly with the Thomsom recording watt meter, I will refer only to that type.

To install the meter in a suitable location, is of the first importance. It should be located in a clean, easily accessible place, free from moisture, vibration and liability to mechanicaal injury. If these conditions are not complied with, trouble is likely to develop sooner or later, and prevent the meter recording correctly—causing it in almost every case to run slow, and therefore in favor of the customer, hence, to the company's loss.

The meter should be inspected within a day or two after having been installed, to make sure that it is running properly, and that all connections are tight, etc. It is advisable to have the meter placed where it can be readily got at, so as to facilitate reading and inspection; although it would seem to be the aim of some companies, to put them in the most inaccessible places, as for instance, under shop counters, near the ceiling in the show windows of stores, etc. Should the meter be located in a damp place, the commutator quickly becomes tarnished, rust attacking parts of the recording gear and accumulating on the permanent magnets, sometimes to such an extent as to choke up the space between the magnet poles and the revolving disc, thereby stopping the meter. I have frequently seen this occur, and as the effect is gradual, it is not likely to be noticed (unless regular inspections be made) until after many weeks, in some cases months, during which time the company would be steadily losing income on that meter.

When dust or dirt get into the meter, as it will in some places unless extra precautions be taken, it is liable to cause friction in the recording mechanism, and by collecting on the armature and copper disc, put a load on the meter, causing it to run slow. Care should therefore be taken to fill all spaces round the wires where they enter the meter. This precaution is very necessary when the meter is situated in places where such insects as cockroaches abound. I have seen a fully loaded meter (installed in a butcher shop) stopped by cockroaches collecting on the disc and armature. This meter was removed and another substituted, which was provided with rubber diaphragms, over the holes where the wires entered, and extra care was taken to fill all crevices, where it was thought the insects could enter; in spite of which, however, it was found after a month's time to have stopped from the same cause.

Vibration is liable to fracture the jewel and weaken the permanent magnets; meters should not therefore be placed near elevator shafts, nor in places where they are liable to be effected from this cause. Rough handling either before or when the meter is installed, is frequently the cause of its not recording correctly, hence the advisability of frequent inspections. There is probably no meter on the market more perfect in its construction, or more reliable in its working, than this type which, when installed with ordinary care, I have always found an instrument whose constancy and sensitiveness, remain unchanged.

An Electrical Parrot Teacher.

According to London *Electricity* a Mr. Hill of Manchester, who seems to have invented a number of curious and useless contrivances, has lately devised an electrical parrot teacher, which is made up of a phonograph, a motor, an electromagnet, a battery, a mirror, an electric bell, a piece of sugar, a cage and a parrot. One advantage is that the parrot can be taught anything, even Chinese or Russian.

Areas of Circles.

Our contemporary, the London Electrician, gives the following simple rule of Mr. Gray. Instead of multipliyng the square of the diameter by 0.7854, his rule is to multiply by .7, repeat the result, double it and repeat the latter again, writing each successive product one decimal place to the right and add up the figures; the result can readily be shown to be the exact equivalent of multiplying by the above constant.

Electrical Power Transmission—II.

BY LOUIS BELL, Ph. D.

Concerning Electrical Energy.

10. In electric currents we have a very different state of things. The energy supplied by the electromotive stress instead of becoming potential as electrostatic strains, does work and is transformed into other kinds of energy, thermal or chemical, mechanical or luminous.

When a stress of whatever kind is applied to a body, only a limited amount of energy can be supplied by it so long as the energy remains potential. Thus in our box of jelly before referred to, a twist of given intensity applied to the stick, as for instance by a string wound around it and pulled by a given weight, can only transfer energy until the stresses produced in the jelly come to an equilibrium with it. On the other hand if the box were filled with water and the stick were the axle of a sort of paddle wheel, the very same twist could go on communicating energy to the water as long as one chose to apply it.

This roughly expresses the difference between electric charge and electric current, viewed from the standpoint of energy. An electromotive stress applied to a wire *charges* it and then the transfer of energy ceases. If the same stress be applied under conditions that allow work to be done by it, energy will be transferred so long as the stress is kept up. In an open electric circuit we have a charge as the result of electromotive stress. When the circuit is closed, *i.e.* when a continuous medium is furnished on which work can be done, we have an electric current. The amount of this work and the flow of electrical energy that produces it, depend on the nature of the circuit. Certain substances, especially the metals, and of metals notably copper and silver, permit a ready transfer of energy in and about them. Such substances are called good conductors. The real transfer of energy doubtless takes place *via* the ether, but its amount is limited by the amount and character of the matter on which work can be done.

FIGS. 1 AND 2.

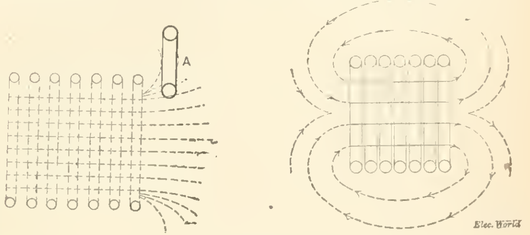
11. Whenever the strains in the ether, such as we recognize in connection with electrical charge, shift through space as when a current is flowing, other strains bearing a certain relation to the direction of flow are made manifest. Where there is a rapid and intense flow of energy these strains are very great and important compared with any electrostatic strains that exist *outside the conducting circuit.* In other cases they may be quite insignificant. These strains are electromagnetic and with them we have to do almost exclusively in practical electrical engineering. They exist wherever there is a moving electrical strain, whether produced by moving a charged body or causing the charge upon a body to move.

Both kinds of strains exist in radiant energy, as in other cases of flowing energy. The stresses in electromagnetic energy are at right angles both to the electrostatic stresses and to the direction of their motion or flow. If for example we have a flow of electrical energy in a straight wire (Fig. 1), the electromagnetic stresses are in circles about it.

If A be a wire in which the flow of energy is straight down into the paper the electro magnetic stresses are in circles in the direction shown by the arrow heads. If the wire be bent into a ring (Fig. 2) with the current flowing in the direction of the arrows, then the electromagnetic stresses will be (following Fig. 1) in such direction as to pass downward through the paper inside the ring

12. These electromagnetic stresses constitute what we call a *magnetic field* about the wire. The intensity of this field can be increased by increasing the flow of energy in the desired region in the systematic way suggested by Fig. 2. If, for example, we join a number of rings like Fig. 2 into a spiral coil shown in section in Fig. 3, in which the current flows downward into the paper in the lower edge of the spiral, there will be produced a magnetic field in which the stresses have the directions shown by the arrows. Such a spiral constitutes a genuine magnet, and if suspended so as to be free to move would take up a north and south position with its right hand end toward the north. In and about the spiral there exists a magnetic "field of force," which is merely another way of saying that the ether there is under stress. Its condition of strain is somewhat analogous to that about an electrofied body, and, as in that case, there is no work done on the ether after the strains are once established. While this is being accomplished work *is* done just as when a body is charged.

13. If now setting up such an electromagnetic field requires energy to be spent by causing a current to flow in the spiral, we should naturally expect that if the same field could be set up by extraneous means, energy would momentarily be spent on the spiral in producing stresses and strains similar to those that set up the original field. This is found to be so, the process working backward as well as forward.



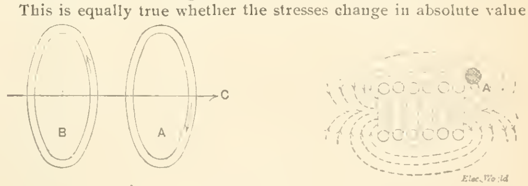
FIGS. 3 AND 6.

If, for example, we have two rings (Fig. 4), and by sending a current around one, transfer energy to the medium outside it, this energy will set up an electromotive stress in the other ring. The direction of this stress is not at once obvious, but we can get a pretty clear idea of it by considering the work done. If current is started in A (Fig. 4), in the direction shown, electromagnetic stresses are produced in the direction of the arrow C. If these are to do work on B, the electromotive stress in the latter cannot have such a direction as to set up on its own account a magnetic field that would *assist* that of A, otherwise we could increase the field indefinitely without added expenditure of energy. Therefore the electromotive stress in B, and hence the current, must be in a direction opposing the original current in A, as shown in the figure.

In like manner if the current in A be stopped and the field due to it therefore changes, there is a change in the electromagnetic stresses about B that again sets up an electromotive stress in it. It, however, this change of stress is to do work the electromotive stress in B must be of such direction as to oppose by its field the change in the field of A—*i. e.*, it must change its direction and will now give us a current in the same direction as the original one in A. All this follows the general law, that if work is to be done by any stress it must be against some other stress. There can be no work without resistance.

In Fig. 4 we have the fundamental facts of current induction on which depend most of our modern methods of generating and working with electrical energy. Summed up they amount to saying that whenever there is a change in the electromagnetic stresses about a conductor, work is done on it, depending in direction and magnitude on the direction and magnitude of the change in the stresses.

This is equally true whether the stresses change in absolute value



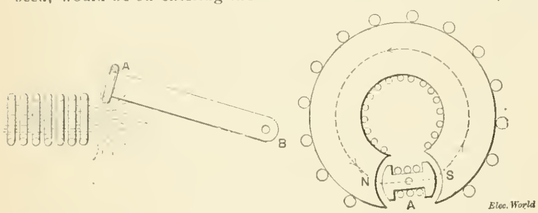
FIGS. 4 AND 5.

or whether the conductor changes its relation to them. Thus in Fig. 4, if A carries an electrical current the result on B is the same whether the field of A changes through cessation of the current or whether the same change in the stresses about B is produced by suddenly pulling B away from A. The rate at which work is done depends on the rate at which the stresses are caused to change, as might be expected. While the stresses are constant with reference to the conductor in which current is to be induced, no work can be done upon it.

14. These principles form the foundation of the dynamo, motor, alternating current transformer and many other sorts of electrical apparatus. Their details may differ very widely, but we can get all

the fundamental ideas from a consideration of Figs. 3 and 4. To somewhat define the specific idea of the dynamo, consider what happens when a conducting wire is thrust into a magnetic field such as is produced by a coil, as in Fig. 5. As in Fig. 3, let the current in the coil be flowing downward into the paper in the lower half of the figure. A is the wire perpendicular to the plane of the paper in front of the coil, its ends being united at any distant point that is convenient. Knowing that moving the wire into the field will set up electromotive stresses in it, we can as before determine their direction by remembering that work must be done. That is (see Fig. 1), the induced current will flow through A downward into the paper. In passing out of the field the current would be upwards.

We have so far neglected the rest of the circuit. To be exact we should consider it as in Fig. 6. Following the same line of reasoning as in Fig. 5, we see that while the ring A is entering the magnetic field the current induced in it must be opposite to that in the inducing coil (see Fig. 4). When the coil is leaving the field, however, this direction will be reversed. Considering the coil A as a whole, we see that so long as the total field tending to set up stresses in it is *increasing*, a current will be induced opposed to that in the inducing coil. While the total field is diminishing, the induced current will be in the other direction. The work that is spent in moving the coil A will for the most part reappear as electrical energy in that coil. Arrange the parts of Fig. 6, so that the motion of A can be accomplished uniformly and continuously and we should have a true, though rudimentary dynamo. Such a structure could be made by fixing A to the end of an arm pivoted at the other end and then revolving the arm so that at each revolution the coil A would sweep through the field of the magnetizing coil (see Fig. 7). The result of this, as we have seen, would be on entering the field a current in one direction, and



Figs. 7 and 8.

on leaving, a current in the other. There would thus be an alternating current developed in the ring A. If it were cut at some point and wires led down the arm and to two metal rings on the axis B we could obtain, by pressing brushes on these rings, an alternating current in any outside circuit. To make more of the revolution of the arm useful we could arrange coils in a circle about B. There would then be an alternation as A passed each coil.

All these devices, however, would produce comparatively weak effects because it is difficult to produce powerful magnetic stresses in so simple a way. There are very few materials in which magnetic stresses are easily set up or propagated. Chief among these is iron, which bears the same relation to magnetic effects that copper does to electrical ones. By giving to the coil in Fig. 7 a core of soft iron the electromagnetic effects obtained from it would be greatly enhanced. They are comparatively feeble in air and the more iron we put in their path the better. Developing this idea we have in Fig. 8 a much better device for setting up electric currents. Here the coil of Fig. 7 is wound around an iron core the ends of which are brought near together. The arm of Fig. 7 is also of iron with enlarged ends and the ring A is replaced by a coil of several turns.

The magnetic stresses brought to bear on the coil A are thus made comparatively powerful. Following out on Fig. 8 the reasoning applied to Fig. 7, we see that considerable electromotive stresses would be set up by the revolution of A, alternating in direction at each half revolution. In fact A is the armature of a simple alternating dynamo, having two poles N and S, so-called from their magnetic relations (see Fig. 3).

We have not thus far considered the source of the electromagnetic field involved. It may be obtained as shown by utilizing the electromagnetic stresses set up by a wire conveying electrical energy or on a small scale from permanent magnets. The essential fact, however, is that by forcing a wire through a region of electromagnetic stress, electromotive stresses are set up in that wire, the action in every case being in such direction as to compel us to do work on the wire. This work appears as electrical energy in the circuit including the moving wire.

(To be continued.)

Electrodynamic Machinery—XVI.

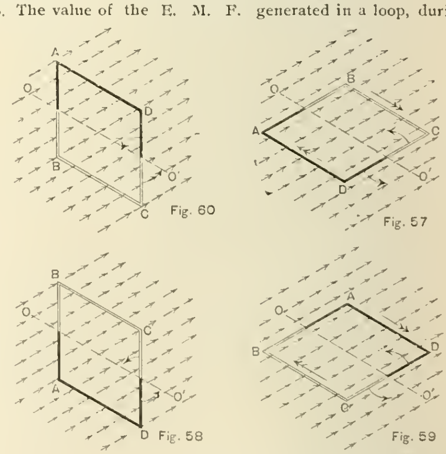
BY E. J. HOUSTON AND A. E. KENNELLY.

80. Let us consider the case of a square conducting loop A, B, C, D, Fig. 57, having its plane parallel with the uniform magnetic flux shown by the dotted arrows. If this loop be rotated about the axis OO, which is at right angles to the magnetic flux and symmetrical with regard to the loop, so that AD descends, and BC ascends, these sides, which cut flux during the rotation, will have E. M. F.'s generated in them, in accordance with Fleming's hand rule already described in sec. 70, and in the direction shown by the double arrows. The sides AB, and DC, which do not cut flux during the motion, will add nothing to the E. M. F. generated. The figure shows that while the sides AD and BC, have oppositely directed E. M. F's, yet regarding the entire loop as a conducting circuit, these E. M. F's tend to produce a current which circulates in the same direction.

81. As already pointed out, the value of the E. M. F. generated in the sides AD and CB, of the loop by the cutting of the flux, will depend upon the rate of filling and emptying the loop with flux, and it is evident that this rate is at a maximum when the loop is empty, *i. e.*, in the position it occupies in Fig. 57, when the plane of the loop coincides with the direction of the flux, and the motion of its sides is at right angles thereto; for, when the loop reaches the position shown in Fig. 58, namely, when it is full of flux, *i. e.*, when its plane is at right angles to the flux, then at that instant the rotation of the loop neither adds to diminishes the amount of flux enclosed, so that the E. M. F. in the loop is zero.

82. Continuing the rotation of the loop in the same direction, the E. M. F. generated will increase from this position until the position shown in Fig. 59 is reached, where the plane of the loop is again coincident with the plane of the flux, but in which the side AD, has moved through 180°, or one-half a revolution from the position shown in Fig 57, and the directions of E. M. F's in the wire, as shown, will be changed so far as the wire is concerned, being now from A to D, instead of from D to A, in the conducting branch AD; and from C to B, instead of from B to C, in the conducting branch BC. The direction of E. M. F. around the loop, will, therefore, be reversed. Consequently the loop ABCD, during its first half revolution as shown in Figs. 57 to 59, has an E. M. F. in the same direction; and, during the remaining half revolution, has its E. M. F. in the reverse direction, as shown.

83. The value of the E. M. F. generated in a loop, during its



Figs. 57, 58, 59 and 60.

rotation depends upon the flux density, the area of the loop, and the rate of rotation.

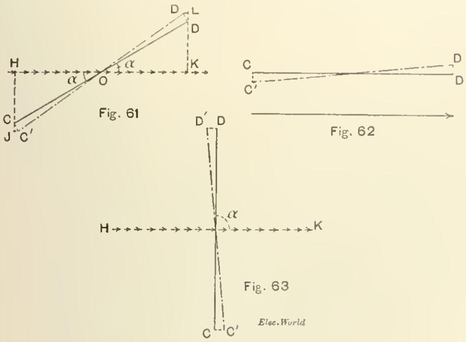
Assuming the side of the loop CD, to occupy the position shown in Fig. 61, making an angle, with the direction HK of the flux, then the E. M. F. generated in the loop at this instant is the rate at which flux is being admitted into the loop. If l cms., be the length of the side of the loop or the length of AD, in Fig. 57, the amount of flux embraced at this instant will be $l\,\mathfrak{B} \times 2DK$. During the next succeeding small interval of time dt, if the angular velocity of the loop, ω radians per second, carries it to the position C'D', the amount of flux admitted during that time will be $l\,\mathfrak{B} \times 2DL$. But DL = DD' × cosine of angle D'DL, and its

angle is equal to the angle α, so that DL = DD′ $\times$ cos α DD′ will be $\frac{l}{2}\,\omega\,dt$ cms. in length, since the radius OD = $\frac{l}{2}$; consequently, the flux admitted into the loop during this brief interval of time dt, will be

$$d\,\Phi = 2\,l \times \frac{l}{2}\,\mathfrak{B}\,\omega\cos\alpha\,dt, \text{ or } l^2\,\mathfrak{B}\,\omega\cos\alpha\,dt$$
$$= \Phi\,\omega\cos\alpha\,dt$$

so that
$$\frac{d\,\Phi}{dt} = \Phi\,\omega\cos\alpha$$

and thus, the instantaneous rate of increase in the flux at the instant



FIGS. 61, 62 AND 63.

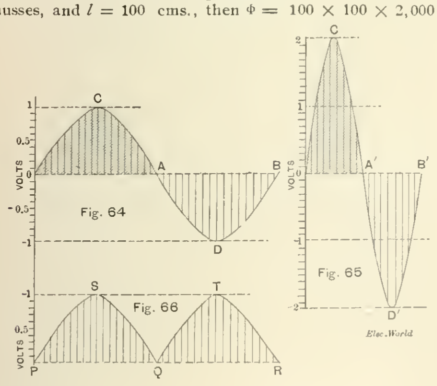
of time in which the loop has reached the position OD, and if α be the angle which the loop includes at any time with the direction of the flux, the E. M. F. e, will be generally expressed in C. G. S. units by

$$e = \Phi\,\omega\cos\alpha$$

Φ being the maximum amount of flux in webers ($l^2\,\mathfrak{B}$), which the loop can embrace. When the plane of the loop coincides with the direction HK of the flux, as shown in Fig. 62, DD′, is brought into coincidence with DL, or the cosine of α is 1. So that the E. M. F. e, in the loop has a maximum value, and is equal to $\Phi\omega$, while when the loop is at right angles to the flux, or as shown in Fig. 63, DD′, the succeeding small excursion of the loop, is at right angles to DL, or cosine $\alpha = 0$, so that $e = 0$.

84. If $\mathfrak{B}'$, as in the case represented by Figs. 57 to 60, be two kilogausses, and $l = 100$ cms., then $\Phi = 100 \times 100 \times 2{,}000 = 20$ megawebers. If the loop be rotated in the direction shown at an angular velocity of 50 radians per second ($\frac{50}{2\pi}$ revolutions per second), the E. M. F. e, will be

$$e = 20{,}000{,}000 \times 50. \times \cos\alpha, \text{ or } 100{,}000{,}000 \cos\alpha$$
$$= 1 \cos\alpha \text{ volt}$$



FIGS. 64, 65 AND 66.

85. The E. M. F. generated by the loop, therefore, varies periodically between 1, 0,—1, 0, and 1. If these values be plotted graphically as ordinates, to a scale of time as abscissas, the curve shown in Fig. 64 will be obtained, where the distance OA represents the time occupied by one half revolution of the loop, the E. M. F. being positive from O to A, and negative from A to B. If now, the speed of revolution be doubled, *i. e.*, increased to 100 radians per second, the time occupied in each revolution will be halved and O′A′, Fig. 65, will be half the length of OA, but e, will be doubled as shown. The shaded area O C′A′, in Fig. 65, is equal to the area OCA, of Fig. 64. The E. M. F. generated by the loop is alternating, being positive and negative during successive half revolutions, but, by the aid of a suitable commutator, the E. M. F. can be made unidirectional in the external circuit, as represented in Fig. 66, where the curve PSA, corresponds to OCA, in Fig. 64 and QTR, to ADB.

(To be continued).

Practical Notes on Dynamo Calculation—XVII.

BY ALFRED E. WIENER.

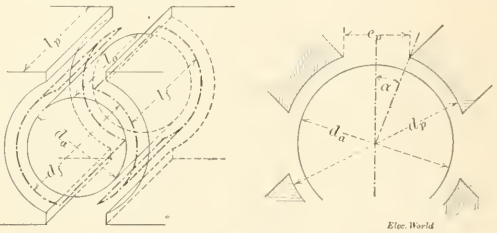
33.—*Actual Field Density of Dynamo.*

According to the definition given in section 31, the actual field density of a dynamo is the total useful flux cutting the armature conductors, divided by the area of the actual magnetic field, thus

$$\mathcal{H} = \frac{\Phi}{A_f}, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (93)$$

where $\mathcal{H}$ = Field-density, in lines of force per sq. inch;
Φ = Useful flux, in webers, from formula (91) or (92) respectively;
and A_f = Actual field-area, in square inches, *i. e.*, area occupied by the effective armature conductors.

This actual field density (93) is, in general, slightly different from the original field density, selected from Table IV, section 4, and used for the determination of the length of armature conductor, for the reason that, in practice, the length of the polar arc is not fixed with relation to exactly obtaining the assumed field density, but is dimensioned according to a construction rule having refer-



FIGS. 46 AND 47.

ence to the ratio of the distance between pole-corners to the length of gap spaces (see section 34).

It would be an easy matter to obtain the length of the polar arc and the percentage of its embrace from the assumed field density, for, supposing that, in a machine with smooth armature, the length of the pole pieces is equal to that of the armature core, we would simply have to make the sum of the lengths to the polar arcs of half the number of poles = $\frac{\Phi}{\mathcal{H} \times l_a}$, or the percentage of the polar arc:

$$\beta = \frac{\Phi}{\mathcal{H} \times l_a \times d_f \times \frac{\pi}{2}} \ldots\ldots\ldots (94)$$

in which
β = percentage of polar arc, or quotient of sum of all polar arcs by circumference of mean field-circle;
Φ = Useful flux, in webers, from (91) or (92);
$\mathcal{H}$ = Assumed field-density, in lines per sq. inch, from Table IV;
l_a = Length of armature core, in inches, formula (12); and
d_f = Mean diameter of magnetic field, in inches, which is given by the core diameter of the armature, by the height of its winding space, and by the clearance between the armature-winding and the pole-pieces: $d_f = d_a + h_a + k_{12}$; see section 34.

But since the polar embrace so determined may not be within the limits of practical design in accordance with the construction rule referred to, it is advisable not to follow the process indicated by formula (94), but to fix the distance between the pole-corners, and thereby the percentage $\mathfrak{B}$, by that rule, and to calculate the actual field density corresponding to the same by formula (96) or (100), respectively.

This latter method is in no way objectionable, as the new, actual value of $\mathcal{H}$ only enters the calculation of the magneto-motive force,

and the change does not affect any of the previous calculations concerning the dimensions and the winding data of the armature. For, according to formula (90), the same E. M. F. will be generated by a certain number of conductors moving at a constant speed, as long as the total useful flux remains the same; the E. M. F. generated by a certain armature, therefore, remains constant as long as the product of field-density and field area is kept at the same value, and it matters not whether this product is made up of the original field density and an area corresponding to the polar embrace found from formula (94), or of a larger actual density and a correspondingly reduced field-area.

(*a*) *Smooth Armatures.*

In *smooth* core armatures, Fig. 46, the area A_f, occupied by the effective conductors, is obtained from:

$$A_f = d_f \times \frac{\pi}{2} \times \beta' \times l_f \text{;} \qquad (95)$$

the actual field-density, therefore, by inserting (95) into (93), can be found:

$$\mathcal{H} = \frac{\Phi}{d_f \times \frac{\pi}{2} \times \beta' \times l_f}, \qquad (96)$$

where $\mathcal{H}$ = actual field density of dynamo, in lines of force per square inch;

Φ = Total useful flux of machine, in webers, from formula (91) or (92);

d_f = Mean diameter of magnetic field, in inches;

β' = Ratio of effective field circumference, obtained from the percentage of polar embrace, β, by means of Table XXXII, section 20.

l_f = Mean length of magnetic field, in inches;

$l_f = \frac{1}{2}(l_a + l_p)$; l_a = Length of armature core, in inches;

l_p = Length of polepieces, in inches.

(*b*) *Toothed and Perforated Armatures.*

For toothed and perforated armatures, the area A_f, occupied, in the magnetic field, by the effective armature conductors, cannot be directly calculated from the dimensions of the armature core, since the path area of the actually useful flux cutting the conductors depends upon too many conditions as to be formulated satisfactorily, and it is, therefore, advisable to compute the actual field density $\mathcal{H}$ directly from the electrical data of the armature.

According to chapter 1, the E. M. F. generated per foot of effective armature wire moving at a velocity of 1 ft. per second in a field of the density of 1 line p. square inch, is $\frac{72 \times 10^{-8}}{b}$ volt, if there are b bifurcations of the current in the armature.

For the total effective length of L_e feet of conductor moving at the speed of S feet per second in a field of density $\mathcal{H}$, therefore, the E. M. F. generated is

$$E = \frac{72 \times 10^{-8}}{b} \times L_e \times S \times \mathcal{H}, \qquad (97)$$

from which follows the field-density:

$$\mathcal{H} = \frac{b \times E \times 10^8}{72 \times L_e \times S} \qquad (98)$$

(To be continued.)

Notes on the Management of Railway Power Stations—VI.

BY GEO. T. HANCHETT.

The Switchboard.

The switchboard is the position of all the electric control of the station. In the design of a station where few men are in charge, it is always well to have it near the throttle and have no long runs in case of accidents. When trouble comes in an electric power station it comes like a flash and in an instant there is trouble everywhere. It requires a cool-headed man to do the right thing at the right moment and even then he should not be handicapped by a poor arrangement of the points of control. If a man, however good an electrician he may be, is not familiar with a switchboard, he should religiously let it alone in time of trouble. Matters may be made worse instead of better by turning a rheostat handle the wrong way or manipulating the wrong rheostat or switch.

The motoring of a dynamo sometimes occurs and is more apt to occur with a well designed series generator than one poorly designed. In the writer's opinion the excellence of the design of a compound machine, other things being equal, is inversely proportional to the number of series turns on its magnets. This being very small on a good generator the equalizer does but little toward preventing a machine from motoring. In fact, it is possible to successfully operate two compound generators in parallel with the equalizer disconnected, provided the series-turns are very few in number.

When a generator motors it is usually due to carelessness. The switchboard ammeter should be under sufficient supervision to detect the falling off of the load long before the generator has a chance to motor. If, by any chance the engine speed falls off or from some other cause the voltage of the generator falls, due to improper governing, the load will gradually come off the machine. While in this state the trouble may be corrected by the rheostat. If, however, the generator has started to take current from the bus bars, throw the double pole switch as quickly as possible. Build the machine up to voltage by means of the rheostat and throw it on again adjusting the rheostat till it takes its proper increment of the load.

In throwing a large machine on to a pair of bus bars on which is only one machine, have its voltage a little low rather than high; remember that if the capacity of the large machine is great that it voltage will become the bus bar voltage as soon as contact is made. If, therefore, the voltage of this machine is high the chances of motoring the smaller dynamo are exceptionally good even in spite of the equalizer.

A short circuit or heavy load is a most frequent source of trouble. If there is one generator in circuit and a short circuit occurs, the engine groans and thumps, the brushes spark furiously and emit a screeching sound, then the circuit breaker throws and then it means a good governor or a runaway. The whole occurs very quickly and is sure to confuse a man not familiar with such things.

The writer is heartily in favor of a circuit breaker, which, instead of throwing the circuit open will act like a double throw switch and will throw on to the generator a load say 50 per cent. of its capacity. This will save a strain on both engine and generator. Shunting the circuit breaker is another means of accomplishing the same end. The circuit breaker must in this case be set with the shunt in place, otherwise it is no protection. The shunt should also be so proportioned that on dead short circuit with the shunt in series and the circuit breaker open, the resultant load is not over the capacity of the machine, or, if there are several circuits, a proportional amount. It should be of material heavy enough to carry the full current load. A circuit breaker should be constructed with flash contacts. The arcing at opening will then be so slight at the real contacts as not to fuse them and possibly prevent its being effectively closed again.

The closing of a circuit breaker should involve four steps, in the following order.

1. Open the single pole switch on that circuit.
2. With a file remove any burs or burns on the contacts.
3. Close the circuit breaker and by pressing the trigger be sure that it opens readily and freely.
4. Finally close first the circuit breaker and second the single pole-switch.

If the circuit breaker immediately comes out again repeat the operations and, holding it in for an instant, read the ammeter and thus gain an approximate idea of how short the circuit is, and, if serious, send a man out at once. If the circuit breaker is shunted the ammeter will be a very accurate indicator of the magnitude of the trouble and the instant of its removal. The voltage at the cars in such a case would be very low and the motorman should be taught to recognize this as a sign of trouble and to cease to call for current from the line till the removal of the difficulty.

In the case of a thunder storm some managers think it wise to shut down and disconnect. If, however, it is decided to run, do not go near the switchboard any more than necessary. Rely on the arresters. Have an extra generator or two turning over at full voltage ready to take the load if a machine becomes disabled. The volume of a lightning discharge is seldom heavy after it reaches a machine. The great danger is the puncturing of the insulation and the grounding of the commutator and armature segments. The reactance of the field coils usually effectively protects them. If it is decided to shut down it is well to heavily ground the trolley systems. This will prevent, in a measure, the discharge going through motors or instruments.

It is well to thoroughly familiarize oneself with all the wires of a switchboard. It is not enough to know that rheostat No. 1 controls the field of machine No. 1. The man in charge should know just how and where the wires go. Such knowledge will be invaluable in time of trouble. It will give a quick comprehension on seeing the results of an accident on the switch-board as to its cause; and second, it will be especially valuable when it is desired to use

the switchboard instruments for experimenting or testing. Even in large and well arranged stations the switchboard instruments are often the only ones that the station manager has at his command, unless he possesses some of his own which he is willing to use in the company's service.

The well arranged switchboard has the following properties:—

The three-pole switch comprising plus, minus and equalizer is low down. It has its hinge below and not above This rule is very seldom followed. A switch if hung the opposite way may do untold damage by falling shut, whereas, if its hinge is below, the very slight tendency to fall open, if such could be claimed at all, is tenfold counteracted by the friction of the jaws. Of course heavy jack-knife switches have springs to hold them open, but these cannot always be relied on and the writer knows of several well arranged stations where the switches are propped open by sticks when not in use.

Another very common mistake is to place the circuit breaker last on the line as it leaves the switchboard. In the writer's opinion safety devices should be as near as possible to the source of power.

The first thing on the line after the bus bars should be the circuit breaker. Taking into consideration a simple circuit: it is possible for a short circuit to occur anywhere on the line, and if the safety cut out is located at the end of the line, it is worthless and it becomes of more and more value as its position approaches the dynamo, for it will only be operative when the short circuit takes place on the dynamo side of it. For this reason there should be at least a heavy fuse at the end of the rocker cables on the dynamo. The writer has encountered some cases where the equalizer wire has been fused. This usually does but little harm as the current in the equalizer is nil when all is working properly. If, however, the current in the equalizer is so strong that it will blow the fuse, that is the very time when the equalizer circuit should be intact even at the expense of the insulation on the wire.

The position of the instruments should be carefully chosen. The voltmeters should have a board to themselves, as they are liable to be in error by the presence of wires carrying heavy currents. The ammeters may be on the main switch board, but should be as far from heavy current wires as their nature will permit.

On the inverse principle of the circuit breaker the lightning arrester should be as far from the bus bars as possible. It is well to have a special board for them removed from the switchboard. They can then readily be inspected after a thunder storm, and the arrangement makes the main switchboard safer for the operators while the thunder storm is in progress. These changes are so slight and so easy to make that it is possible to materially improve the arrangement of the switchboard even after it has been installed.

Ammeter and voltmeter readings should be taken every fifteen minutes. From these the daily load curve can be plotted and it will be of great value in economically operating the station. In reading the instrument take neither the highest or lowest reading, but the mean of the two. If the load is very high wait an instant; it may be a sudden pulse of current which will not come again. Such a reading would have but small value to the engineer studying the load and would tend rather to mislead.

It is well to note the voltage when a single machine is operating and by comparing it with the current load determine whether the machine overcompounds as rated.

Compound machines are of little value when run in parallel as far as regulating the potential to a constant point is concerned, for different combinations of dynamos will give different potentials at exactly the same load even though they are all adjusted to the same loss. Their merit lies in the fact that the potential rises when the load comes on and even though it does not compensate, as it should for the loss in the line, it tends to improve matters. This applies to power only. In the case of lighting this property, as Prof. Roberts has shown in a recent article, is very prejudicial to long lamp life.

It sometimes happens that the rheostat of a machine is obliged to be turned as far as it will go on a heavy load. Theoretically it should not need to be turned at all, but practically it needs some adjustment on account of the increased resistance of warm field coils. In case of this adjustment being beyond the range due to incorrect compounding, adjust the shunt on the series coils, increasing its resistance.

Bear in mind that the shunt on the series coils is to be let alone unless the compounding of the series is wrong, or it is desired to alter it. Mere drop of voltage should be adjusted by speeding the dynamo.

All parties except those specially privileged should be excluded from the dynamo room. Aside from the inconvenience the vandalism of some people is beyond belief. The writer knows of one case where the rules were somewhat slack. As a result on one occasion the management found nails driven in the field magnets, sand in the oil, and the bus bars heavily short circuited.

Great mistakes are made in the installation of fuses. It is possible by using a short fuse with heavy terminals to practically double its capacity in which case its value as a safety device is gone.

Paint all cables in and about the switchboard with an insulating paint. There will always be trouble enough about grounds and short circuits on the line, and there is no excuse for them in the station. Never place lightning arresters in a wire tower or near where the feeders leave the switchboard. The arrester should be placed so that it is impossible for the discharge to find any path except through the ground circuit provided for it.

The switchboard should be well lighted both in front and behind especially the measuring instruments. Five lamps is none too many, even for a single panel. Don't rely on the general illumination of the station. The switchboard should have every convenience for the rapid detection and immediate removal of faults.

Remember that the ground is one of the dynamo terminals; therefore keep all bolt Leads or other methods of attaching to the switchboard as far as possible from switch jaws and circuit breakers, and when they are necessary at those points, insulate them fully. The arcs that occur on a 500-volt switchboard are not small and they are quick to take advantage of such defects.

(To be continued.)

Fly-Wheel Accidents—II.

BY J. J. FLATHER.

Subsequent events showed that the commutator of the generator driven by this engine sparked badly, and was soon enveloped in a circle of fire and "looked as though red hot." The engineer pulled out the circuit breaker on the generator and the engine immediately speeded up; he started back to shut the throttle, but by this time the engine was racing at a very high speed (as shown by the force of the explosion) and he was barely able to close the valve when the wheel went to pieces.

While closing the throttle a sharp report was heard at the generator, and it was at this time, probably, that the dynamo pulley exploded, followed by the breaking of the belt and bursting of the fly-wheel. The excessive rim speed (not less than 9,660 feet per minute at time of rupture) had given a tremendous energy to the heavy wheel, which continued its speed even with a closing throttle. Un 'er these conditions the wheel either parted from the influence of centrifugal force alone, or the piling up of the belt or other obstruction in the wheel pit might have produced a shock which was sufficient to cause the wheel to let go. This may also account for the lifting of the shaft from the out-board bearing and the breaking out of the front of the main pillow block, which was shown to have occurred.* Another case worthy of note is the accident which occurred at Lynn, October, 1890. This attracted much attention at the time, as the case was complicated by a fire. It will be remembered that twenty-three insurance companies were sued by the Lynn Gas & Electric Light Company, which was awarded the full amount claimed for wreckage of the building and machinery. The testimony seemed to indicate that a fire in the tower of the station caused a short circuit by enveloping the plates of the lighting arresters in flame, and possibly expanding them so that they came in contact. It was claimed† that this short circuit was brought on so suddenly that it broke the pulley on the jack shaft operating the dynamo then in use, that pieces of this pulley hit others, and according to one phase of the theory, one of the pieces broke off a ball of the governor, so that the engine ran away and caused the damage. Another phase assumes that the jar due to breaking the first pulley caused the next one to break, and that the next, and so on from pulley to pulley until the jack pulley was thus broken; then portions of the pulley were carried by the belt under the fly-wheel and broke that, thus completing the wreck.

Numerous other examples might be given to illustrate the same point, but the foregoing will show that the receiving pulley instead of a defective governor may be primarily responsible for some of the accidents which happen. In order to obtain greater safety in the receiving pulley we frequently find built up wood-rimmed pulleys on a combination of wrought iron or steel and cast iron employed for such wheels.

*"Power," November, 1893.

†E. C. Emery in Cornell Lecture, abstracted in "Power."

Considering the frequency of fly-wheel explosions it becomes an important question how to prevent them.

The history of fly wheel accidents has shown that the governor should not be the sole reliance for safety. It may have been safely depended upon for years, but just at the critical time, when most needed, it has shown itself unequal to its duty. Independent detaching apparatus for automatically shutting down the engine when a given speed is reached, should be employed in addition to the regulating governor. The safety device for preventing admission of steam into the cylinder when the governor balls drop below a given position, is too frequently inoperative, as under the variations of load thrown upon the engine the attendant may, in order to keep his engine running place the stop pin in the usual position for shutting down, so that the balls are thus prevented from falling in case a belt breaks, for instance, and the safety element is lacking. Under these conditions, which are by no means uncommon in electric power service, we are dependent upon the integrity of the governor belt, or gears, to prevent the engine from racing. In case the belt slips or is thrown off, or a pin or key becomes loose and drops out, the engine may speed up considerably above its normal rate before the engineer could close the throttle.

To guard against such an accident by reason of the governor belt failing, ropes are sometimes used intsead of belting. Two ⅞-inch ropes either of which will be ample to drive the governor, will take up no more space than a 3-inch belt and give a double security.

Many accidents which have occurred might have been prevented had there been some means at hand for shutting off the steam more rapidly than is provided in the ordinary screwed throttle. For this purpose there have been used, very satisfactorily, plain butterfly valves placed above the throttle, suitably counterweighted and arranged to be closed by releasing a spring in case of emergency. The precaution of using a magnetic or mechanical stop adopted in many factories, by which the engine may be promptly shut down from any part of the building, might be advantageously applied to a power station where the push buttons could be located near the switchboard and at other convenient points.

Of these the Hatch automatic stop is one of the most successful that the writer has seen in operation, and is admirably adapted to its work.

This consists of a spring operating a train of gearing ending in a sprocket, which is connected by means of a chain with a similar sprocket on the stem of the throttle valve. The engineer, in opening the valve, winds up the spring, which is restrained from action by a detent engaging with a notched wheel. This detent is controlled by a magnet, which may be operated from push buttons placed about the building as required. When the detent is withdrawn the spring rotates the sprocket through the gears and closes the throttle.

One advantage of such automatic closing devices is that the engineer is not exposed to the danger which he incurs when attempting to close down the throttle of a racing engine.

For several years past, since the beginning of fly-wheel accidents in electric railway service, builders have been striving to obtain a wheel better adapted to the trying and severe conditions imposed upon them by the high peripheral speeds and fluctuating loads. Rim and arm sections better proportioned to prevent dangerous shrinkage strains, double sets of arms for wide belts, and better design in the fastenings of sectional wheels have done much to increase the strength of fly-wheels, but even with these improvements there appears to be too small a factor between the working and breaking loads.

Racing is always possible on any engine, and every fly-wheel should be built with such a large margin of strength that it may withstand safely any reasonable excess of speed or sudden shock.

That wheels may be run at speeds greatly in excess of those commonly employed, is evidenced by the fact that cast iron fly-wheels (suitably strengthened by wrought iron or steel rods connecting the rim segments with the hub), are in successful operation at speeds of 7,500 ft. per minute. In saw-mill machinery the speed is even is even greater, approximating, in some cases, 11,000 ft. per minute.

Moreover, in the Howell torpedo adopted by the United States Government, the 14-inch fly-wheel runs at a peripheral speed of 36,660 ft. per minute, while in a larger type of similar torpedo, manufactured by the Hotchkiss Company, the velocity of the 18-inch wheel employed is 42,360 ft. per minute. Before leaving the shops these wheels are run up to a speed about 20 per cent. faster. Such test is not for flying to pieces, but only for the elastic limit, and the wheel must show no deformation after it.

It may also be pointed out that the steam wheel in the Laval urbine, running at 30,000 revolutions per minute, has a peripheral speed of 34,500 ft per minute, although, having regard to the apertures cut in it, this wheel cannot be nearly so strong as a solid one. In the Parsons turbines the 27-inch low-pressure wheel, running at 5,000 revolutions per minute, has a peripheral speed of about 35,400 ft. per minute, though this also has holes in it and is a thin disc which would not stand as great a strain as a solid cylinder. Further, these Parsons wheels have been run, experimentally, at speeds greatly in excess of that given, and they do not appear to show deformation until nearly twice their normal speeds are reached.*

The advantage of employing solid steel cylinders, say 3 ft. in diameter and 3 ft. wide running at 4,000 revolutions per minute, has been suggested by Mr. A. C. Swinton.†

This corresponds to a surface speed of 38,000 ft. per minute, and would store sufficient energy to maintain 66-hp for two minutes with a 5 per cent. variation of speed. If these wheels run at speeds varying from 35,000 to 40,000 ft. per minute, is it not possible to obtain a greater degree of safety than now obtains in fly-wheels which run at less than 6,000 ft. per minute?

To obtain immunity from disaster, which is liable to happen when a fly-wheel is subjected to excessive strains, especially in those cases where shock may occur due to sudden increase of load, it would seem that cast steel or built-up plate pulleys would give the desired degree of safety.

The fact that cast iron has properly no elastic limit, makes it particularly liable to rupture by violent shock, as there is little give to the material when placed under sudden increased strain. On the other hand cast steel is very well suited for such work. When low in carbon (20 to 25 per cent.) the elongation will be about 20 per cent., which is increased to 30 per cent. by annealing; the strength of such steel will vary from 65,000 to 70,000 pounds per square inch. A cast steel fly-wheel, especially if built up, ought then to be from three to four times as strong as a similar cast iron wheel. In the design of large built-up wheels with wide faces, in order to obtain the requisite strength, a greater weight is usually given to the wheel than is necessary for steady running.‡ As an instance of this, Mr. Manning states that with a weight of rim in his wooden rimmed wheel of 32,000 pounds, the speed was very steady and the weight was ample. In the old wheel which it replaced there was about 74,000 pounds. This suggests an additional advantage in the employment of steel which would allow the use of lighter wheels if desired. The lost work due to friction in the shaft bearings would thus be lessened and the relative cost of the wheels would not be as great. The expediency of reducing the weight of pulleys for electric railway service, is, however, doubtful.

Among the special forms of fly-wheels which have been built with a view of obtaining greater safety, may be mentioned those in use at the Mannesmann Tube Works in Germany and Wales. These fly-wheels are run at very high speeds and their rims are wound with wire under tension, in a continuous coil.

The wooden rimmed wheel designed by Mr. Manning to replace the cast iron one which went to pieces in the Amoskeag Mills, Manchester, N. H., three years ago, is a good illustration of special construction. This wheel is 38 ft. in diameter, 9 ft. face, and cost about $7,000, including patterns and special appliances; or less than the cost of the cast iron wheel which it replaced.

The rim is 12 inches thick, made of Western ash plank, laid up in 44 courses or rings arranged to break joint, and securely fastened by lag screws and through bolts. The arms (twenty four in number arranged in two sets) are of cast iron suitably bolted to the rim and hub. The weight of wheel is estimated at 52 tons, of which about 16 tons is in the rim. It has been run at a speed of 7,200 ft. per minute without sign of deformation. Mr. Manning states that the strength of the rim is 10.58 times that of the cast iron wheel which it replaces, assuming the latter to be sound, and hence it can safely be run at a speed equal to $\sqrt{10.58}$, or 3¼ times greater. Several large cast iron fly-wheels have been replaced at the Amoskeag mills since this first wheel was constructed; others have been built to replace fly-wheels which have given way in other mills. Among these may be mentioned one 28 ft. in diameter by 110 inches face, with three sets of arms made for the Willimantic Linen Company, and one 30 ft. diameter, 60 inches face, for the Nashua Manufacturing Company. It is the impression of the writer that such a wheel was built for one of the Lawrence Mills also.

While in Manchester recently, investigating the subject of fly-

*The "Electrician," Aug. 31, 1894.
†"Proc. British Inst. C. E., Vol. cxii."
‡Trans. A. S. M. E." xivi.

wheels and pulleys, the writer was shown a form of wheel designed by Mr. Manning for a 1,500-hp compound engine, which suggests possibilities of special advantage in electric railway and other work where the load is variable, and an accummulator, such as Mr. Swinton suggests, would be desirable.

This wheel is 14 ft. in diameter, with a rim 30 inches face, and 12 inches deep, of plate steel, each plate being ½ inch thick, 30 inches wide, and of a length equal to half the circumference. This mass is riveted together so as to break joints, and bolted to cast iron arms. The weight of the rim is about 50,000 pounds and its circumferential speed 4,100 ft. per minute, which allows a very large factor of safety. With suitably designed cast steel arms low in carbon, such a pulley could be run regularly at double the speed and be practically indestructible if the connections were of ample strength, as it would be well able to withstand any sudden shock liable to be imposed upon it, as well as centrifugal strains acting in the rim. A more radical departure from existing methods in fly-wheel construction is shown in the design by Mr. F. P. Sheldon, of Providence, for the dynamo fly-wheels or accumulators used in the station of the Union Railroad Company, Providence.*

The armatures for these generators are keyed direct to the engine shaft, and the fly-wheels, which act as regulators only, are keyed to the same shaft. The design is novel in that it has no arms, but consists of a hub, disc and rim, the two latter being made entirely of wrought iron. The diameter of the wheel is 18 ft.; the rim is 15¼ inches wide and 16 inches deep, made up of segments of 1⅜ inch and 1⅛ inch plate, assembled so as to break joint with the central web plates, which are 1 inch thick. These plates are cut in 60 degree sections, and two thicknesses riveted together so that the central disc is 2 inches thick; the disc is re-inforced about the hub by two other circles similarly constructed, making the thickness 4 inches up to a diameter of 9 ft.; 1½ inch countersunk head rivets are used in this work, fitted into reamed holes and headed up cold. The hub is of cast iron in two pieces, which are bolted to the web by 2½-inch through bolts. The weight of the wheel is about 40 tons and its peripheral speed 5,650 ft. per minute; the combined weight on the shaft, including cranks, armature and fly-wheel, is estimated at 78 tons.

The fact that perfectly safe pulleys have been thus constructed for special cases, would indicate that whenever engine buyers are ready to pay for the increased safety, engine builders will be ready to furnish the wheel.

It may safely be asserted that fly-wheels will continue to break even with the greatest care used to prevent such disaster; but with the precautions that may be taken such accidents should be rare.

*"Power," April, 1894.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir: Apropos of the discussion now going on in your columns concerning fly wheel accidents, I should like to say a few words.

There are but three ways in which the wheel can fail, namely, tension in the rim, bending strain in the arms, and shearing of the arms from either the rim or hub. The first of these can only be due to centrifugal force caused by excessive speed. Failure in either of the last two ways is the result of suddenly changing the load in the engine, or if the wheel is also used to transmit power, it may be caused by an excessive, although gradually increasing load.

Of course it is exceedingly unlikely that this last method of failure will occur in practice, and there is absolutely no reason why the wheel should fail in any manner but the first, if it is properly designed. If it does, it is the fault of the maker and cannot be blamed upon the circumstances to which the wheel is liable. Now if from any cause the engine races, so that its speed is double, say, it is not the wheel's fault if it bursts. It is an exceptional thing, which the wheel is not expected ever to meet. But there is no excuse for its not being strong enough to withstand all loads that the engine can throw upon it with an ample factor of safety, say four or five. In all cases of fly wheel accidents that ever came to the notice of the writer, the wheel burst either from excessive speed or from some hidden flaw or bad design.

A fact that frequently seems to be lost sight of is, that initial strains are often placed upon the metal in casting, which allow a very small margin of strength. The amount of this is very difficult to determine, but in a poorly designed wheel may be sufficiently great to tear away the arms from the rim when it is cast in one piece. The moral would seem to be to make the wheel in several sections. The bolted joint in the rim may be made as strong as any other portion.

If the spokes are made with an elliptical cross section, as they usually are, the greater resistance to bending is obtained.

In view of the above, which the writer believes to be the facts of the case, it would seem that although fly wheels made of other material than cast iron, and in other shapes, might be better than one ordinary fly wheel, still there is no excuse for the latter's bursting, except from the exceptional cause of excessive speed.

Mamaroneck, N. Y. ARTHUR J. FARNSWORTH.

To the Editor of The Electrical World:

Sir: In an editorial in your issue of November 10th on fly-wheel accidents, it is stated that the strain produced by the sudden imposition of a load and consequent sudden change of speed, is in the nature of a shearing strain as far as the rim itself is concern and of such an order as to be entirely negligible. Elsewhere in the same editorial it is stated, "if weakest at the junction of the rim the arms may thereby be sheared at the rim." Is this not a contradiction?

Boston, Mass. ENGINEER.

[There is no contradiction between the two statements. If a fly wheel is suddenly slowed the tangential stress in the rim due to change of momentum is greater at the outer than at the inner circumference of the wheel, which stress tends to shear the rim around an intermediate circle, or to separate it into two concentric portions. If we imagine a wheel that has been re-inforced by an outside rim held by longitudinal keys, the stress tending to shear the keys is the same that in a solid wheel is equally distributed along circles within the rim, and which, concentrated at the junction of the arms with the rim, where it is greatest, tends to shear these, as referred to in the second statement quoted. The first effect is of course entirely negligible, and was merely referred to in connection with a statement made in the letter under comment—ED.]

Signalling Through Space.

To the Editor of The Electrical World:

Sir: I observe in your No. 19, Vol. XXIV, a note signed "E. A. Grissinger" bearing the above title, and describing a case in which the telegraphic transmission of Morse signals over a telegraph line from Harrisburg to Baltimore was heard in a telephone on a short earth completed circuit extending parallel to another telegraphic circuit running in a direction opposite to that of the Baltimore line.

Mr. Grissinger says: "Induction probably takes place from one telegraph line to another, and then eight miles away the induced current on the telegraph line influences the short telephone line."

Such occurrences are not infrequent in telephony. While no doubt the second translation from the Harrisburg-Pittsburg line to the telephone was inductive, it is much more probable that the first, that from the Baltimore to the Pittsburg telegraph circuit resulted from actual conduction, either by reason of a high or relatively high resistance in the common earth wire at Harrisburg; or else, by reason of surface leakages across supports, on some portion of the route in Harrisburg city or telegraph office, such leakage being attributable to defective insulation.

Boston, Mass. THOS. D. LOCKWOOD.

Central Station Book-keeping.

To the Editor of The Electrical World:

Sir:—I noticed in the review of my book on "Central Station Bookkeeping" that criticism is made on the great amount of paper folded in some of the forms. I am exceedingly pleased to have this point so well brought out, as it affords a chance to state the reasons for encumbering the work with so much apparently useless paper. The point made in the review that the "last ten months' rulings of form 56 'Meter Customers' Register might have been safely left to the imagination of the reader," was fully considered, but in the light of actual experience of the writer in omitting just such parts, and from the fact that but comparatively few bookkeepers are familiar with the style of ledger, and from the further fact that it was expressly desired to call attention to the style of arranging the order of the months to aid in the transfer of amounts from page to page, it was finally decided to add the extra paper, thinking that a little more paper, to make the matter plain, would be better than to run the least risk of not being plain enough.

New York, N. Y. HORATIO A. FOSTER.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Thermo-electric Force of Electrolytes.—The Lond. "Elec.," Oct. 26, abstracts briefly from "Nature," a paper by Mr. Bagard from the "Ann. de Chemie et de Physique" for September; among other things he finds that in all cases the thermo-electric phenomena, the Peltier effect and the Thomson effect, gave results in case of electrolytes similar to those obtained with metals.

Di-electric Power of Ice.—In a recent academy paper by Mr. Piot, the results involved an error, pointed out by Mr. Blondlot; "L'Ind. Elec.," Oct. 25, contains the corrected results; the same issue contains Mr. Blondlot's paper abstracted in the Digest last week.

Induction in Cables.—In "L' Eclairage Elec.," Oct. 13, Mr. Guy gives a method by which the influence of an iron armature of a cable on the induction in the cable can be calculated in a comparatively simple way, if the magnetic qualities of the iron are known.

Vacuum Tubes.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Allingham states that vacuum tubes can be lighted brilliantly by touching them against one terminal of a ¼-inch spark coil; one terminal of the coil lights it more brilliantly than the other and this terminal is the same when the battery connections are reversed.

Origin of Earth Current.—In the abstract in the Digest last week under this heading, the clause in the last line "in a clear atmosphere" should read "with a pressure of one atmosphere."

Earth Currents.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Walker abstracts the paper of Mr. Palmieri, mentioned in the Digest last week, and adds some results of other investigations.

Surplus and Deficit Theory of Electricity.—The Lond. "Elec. Eng.," Oct. 26, contains the first part of an article by Mr. Maycock, in which he describes the theory in which the positive and negative electrifications are considered as representing an excess and a deficiency in the quantity of electricity.

A New Phenomenon.—The Lond. "Elec. Rev.," Oct. 26, gives a brief resume of the experiments of Mr. Lehmann described in the Digest, July 14.

MAGNETISM.

Earth's Magnetism.—An abstract of a French Academy paper by Mr. Tillo, in which he deduces the constants for four periods of this century and draws conclusions therefrom, is published in "L' Ind. Elec.," Oct. 25.

Magnetic Properties of Asbestos.—Mr. Hancock, in the Lond. "Elec. Rev.," Oct. 26, states that he has tried, but has failed to prove that asbestos is magnetic, as stated by Mr. Swinton in the Digest, Sept. 29 and Oct. 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Self-induction.—A German translation of the paper by Dr. Toebler, from the French, mentioned in the Digest, is published in the "Elek. Zeit.," Oct. 25. He describes the method of Maxwell and its modifications; the chief objection to this is the uncertain deflection of the needle near the zero point, due to the fact that the condenser and the self-induction "paralyze" each other mutually, and also that with coils containing much iron there is always a deflection to one side, followed by an uncertain movement to the other. From a large number of measurements made by him he used the method described by Kempe in his "Handbook," which method he describes in detail, adding some minor modifications suggested by himself; among these are that for accurate results measurements must be made with both the closing and the opening current; in the selection of the galvanometer it is very important that its damping is sufficiently great and that the movement of the needle should be sufficiently slow to read the throw of the needle with sufficient accuracy; the d'Arsonval galvanometer would answer the first but not the second condition, and he recommends an astatic Thomson or Siemens galvanometer, especially the latter; the use of mercury for the closing key and the commutator is essential for obtaining the same result with the closing and the opening current. The method consists of a Wheatstone bridge in which the self-induction together with the resistance, forms the fourth arm of the bridge; after obtaining a balance for continuous currents, the battery key is opened and the throw of the needle noted; the self-induction is then replaced by a shunted condenser, with which the measurement is repeated; the self-induction is then equal to the capacity of the condenser multiplied by the square of the resistance shunting the condenser, multiplied by the ratio of the two deflections; under the condition that the resistance in the fourth arm o the bridge is the same in both cases; if the capacity is in microfarads and the resistance in ohms, the self-induction will be in henrys, if the result obtained is divided by one million. He gives a diagram showing the connections for making the test with the usual apparatus and works out several examples. He concludes that this method gives sufficiently accurate results if attention is paid to the points which he mentions. (His measurements appear to refer only to coils and magnets used in telegraphy and telephony.)

Photometry.—A translation of a paper by Mr. Broca from the "Jour. de Physique,"1894, is given in abstract with illustrations, in the Lond. "Elec.," Oct. 26; the title is "Theoretical and Experimental Investigations on the Visual Sensations and in Photometry." He attempts to discover the law of the differential sensitiveness, which is of considerable practical interest in photometry in connection with the best length for a photometer bar. He gives a verification of the Fechner hypothesis; he shows that the sensations of the two eyes are added, and investigates the differential sensitiveness of the eye as a function of the intensity, deducing the law connecting the sensation with the excitation. In studying the degree of accuracy of a photometer, Boguer and Masson give the law that the ratio of the smallest perceptible difference to the total intensity is a constant; Helmholtz has shown that the differential sensitiveness passed through a maximum; the present author undertook similar experiments supplemented by photometric measurements and comes to the practical conclusion that for good photometric work one must work with an illumination of about one carcel-meter (approximately one foot-candle), the observer being about 12 in. from the fields under observation; he shows that it is necessary to have "a perfect symmetry of the beams in regard to the normal to the diffusing surface," and that nothing can be settled about the equal brightness of two fields which are not lighted by beams of the same angle of incidence; most of the errors of photometry he believes are due to the observer moving his head, thus changing the relative positions of the head and the illuminated surfaces. His conclusions are, that the conditions which an accurate photometer should fulfil are: it should be adapted for binocular vision, it should be arranged so that the observer's eyes should always be in a clearly defined position and it should be arranged to be worked with the sources of light changed over when a double measurement is impossible (by the former he means exchanging the positions of the lights and by the latter he apparently means to use a secondary source with which the standard and the unknown light are both compared). He shows that the figure of merit of a photometer has no meaning unless the illuminations of the screen are given; he finds that there is a wide range of illuminations over which the sensitiveness does not differ, but he believes it begins to diminish again under higher illuminations than one foot-candle. In an editorial mention it is stated that a dazzling illumination did not appear to disturb the sensitiveness until 10 to 15 candle-feet were reached.

Photometric Units and Quantities.—In "L'Ind. Elec.," Oct. 25, Mr. Hospitalier suggests a set of symbols for each of the photometric quantities in the system recently suggested by Prof. Blondel (see Digest, Aug. 11, 25, Sept. 22, Nov. 3). As Roman letters have been reserved for abbreviations of the units, Italian and Greek letters for geometric, mechanic and electric quantities and script letters for the magnetic quantities, he suggests using for the photometric quantities bold-faced letters, sometimes called antique or Gothic, like those used by the English for the magnetic quantities. In French six of the seven photometric quantities begin with a different letter and the seventh, intrinsic brightness, is not of sufficient importance to require a special letter, as it has the same dimensions as illumination; he therefore uses the initial letters which are as follows: **I** for luminous intensity, **F** for luminous flux, **E** for illumination and intrinsic brightness, **R** for intrinsic radiation, **L** for lumination or quantity of illumination and for quantity of light or lighting. He asks for discussions of his suggestions.

Measuring the Degree of Incandescence of Lamps.—A translation of a paper by Mr. Crova from the "Comptes Rendus," No. 16, Oct. 15, is published in the Lond. "Elec.," Oct. 26. He shows how the degree of incandescence in lamps can be accurately determined with a spectro-photometer and with sufficient accuracy by a method of his which was recommended by the Congress of 1889; he has shown that in a comparison of two lights of different colors their total intensities are the same as their intensities measured in the portion of the spectrum of a wave length of 582 and gives the proportions of a solution called the 582 solution, which makes the two sources of light identical in color, thus rendering the measurements more accurate; the method may be employed without any trouble. The degree of incandescence in the carcel lamp being taken as unity he finds that that of the arc lamp varies from 1.5 to

1.7 with a consumption of 1,509 and 1,660 watts respectively; for a 16-cp incandescent lamp this figure varied from 1.05 to 1.23, according to the degree of forcing of the lamp; more detailed figures are given for some gas burners including the Auer.

Localizing Faults in Submarine Cables.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Rymer-Jones replies to the criticism (see Digest, Oct. 6) of his recent article (see Digest, Sept. 29). Any one using this method should read the original and his reply; the substance of the latter is briefly, that on board ship a zero method is certainly necessary, while on shore the condenser discharge method is preferable; his way of effecting the result in the zero method is different from the one described by Jamieson; he does not use Poggendorff's battery test for measuring the potential of the cable, as it has disadvantages that his method is intended to avoid; he thinks his method is free from certain drawbacks and he believes that it is novel in its application though not in its principle; he considers the marine galvanometer quite unsuitable for measuring the discharge from a condenser.

Hydrostatic Electrometer.—A description of a new absolute electrometer of Mr. Guglielmo from the "Zeit. fuer Instrumentenkunde," is abstracted very briefly in the Lond. "Elec.," Oct. 26. It consists essentially of a flat dish containing a conducting liquid and communicating with a burette; a truly horizontal metallic disk rests above the surface and when electrified it attracts the liquid and raises its level; to restore the level to its former position some of the liquid must be withdrawn, which quantity is weighed or measured, giving the difference of level and hence the electrical pressure; the level is indicated by a pointer touching the surface of the liquid; saline solutions or acidulated water are preferred to mercury.

Simple Electrical Method for Testing Dynamos and Motors.—In the article abstracted at some length under this heading in the Digest last week, an unfortunate typographical error occurred; in the second column, first page, fifteen lines from the top the expression "$D + E + W$" should read "$D \div E + W$."

Imperial Institute.—A lecture by Dr. Lummer on the objects and the work of the German Reichsanstalt, is abstracted at some length in the "Elek. Zeit.," Oct. 25.

DYNAMOS AND MOTORS.

Sine Curve Controversy.—Referring to the discussion in the American papers, an editorial in the Lond. "Elec. Rev.," Oct. 26, states that the question is obscured by the unfortunate confusion between the induction curve and its resulting electromotive force curve; the question cannot be answered in favor of one form over the others for all possible uses, as the requirements are somewhat antagonistic; it is not clear that the total core loss and any other smaller losses due to Foucault currents may not be increased by any considerable departure from the sine curve; such extra losses over that due to hysteresis would be very small; there can be little doubt that the presence of upper harmonics of large amplitude would be detrimental to power transmission, especially in respect to increasing the drop on inductive circuits and the wattless current in mains of large capacity; it may be questioned whether it is worth while spending much money in designing machines to give an absolutely perfect sine curve; probably no alternator in the market has a curve of induction differing much more than 10 per cent. from the sine curve, and it is questioned whether it is worth while trying to improve on this.

Alternators in Parallel.—In an editorial on the lighting of the city of London, the Lond. "Elec. Rev.," Oct. 26, advises that the parallel running of the Mordey alternators should be abandoned, as it has been found that the liability to a break down of the armatures is enormously increased by running the machines in parallel; the results obtained by running the machines separately have been most satisfactory.

Construction of Dynamos.—The long series of articles by Mr. Richards on the details in the construction of dynamos, which appeared in "La Lum Elec.," is being continued in "L'Eclairage Elec.;" it is profusely illustrated with excellent diagrams, taken apparently mostly from patent specifications.

ARC AND INCANDESCENT LIGHTS.

Continuous and Alternating Current Arcs.—An interesting article by Prof. Fleming is published in London "Lightning," Oct. 25. He gives the results of experiments made by him four years ago to determine the relative efficiencies. The voltmeter was connected to the two carbons, so as not to take into account the energy in the mechanism; for continuous currents the top or positive carbon was cored and the negative solid, while for the alternating both were cored; in order to eliminate the differences in color between the incandescent lamp standard and the arc, a screen consisting of a ruby red glass and one of signal green was used to cut off a given range of the spectrum; with the alternating current the measurements were difficult, as the light intensity seems to go through a regular cycle for three or four seconds, the arc appearing to revolve around the vertical axis; the observations numbered many hundreds and the results are given in the form of curves; from the results the wattages for the red and green rays were calculated; the arcs were run with different currents; curves are given for the mean spherical candle-power corresponding to different values of the power in watts, the curve for the red rays being approximately a straight line while that for the green rays bends upwards; results showed that for a given expenditure of power in the arc, the mean spherical candle-power for alternating currents is less than that for continuous current in about the ratio of 2 to 3, thus for 540 watts continuous current, the mean spherical candle-power of the red rays was 342 and of the green rays 686, whereas for the alternating current the values were 217 and 407 respectively. Observations for different powers with the alternating arc were not taken, but they are to be made and published soon. The alternating arc has an inductive resistance under certain circumstances, especially when hissing, and therefore a wattmeter must be used in measuring the power; the maximum intensity of the continuous current arc for different wattages does not always occur in the same direction. The general result shows that for a given amount of power to be converted into arc light it is more economical, as regards illumination, to use the continuous current. For the continuous current the maximum was at an angle of 40° with the horizon; for the alternating arc with 540 true watts, the maximum intensity was only 575-cp at 48° below the horizon; if the light directly available for lighting a floor space be taken into account, the efficiencies of the two arcs are in the ratio of 6 to 2 in favor of the continuous current, a part of the light lost in the alternating arc may, however, be reflected downwards, but would never decrease the first mentioned ratio; such a reflector must be small and placed close to the arc; with continuous current arcs it is not absolutely necessary to have the positive carbon cored but with the alternating current both carbons must be cored; the alternating arc is never quite silent, but the noise can be controlled to a great extent by the quality of the carbon and the selection of the frequency; a further disadvantage is in the production of a lag in the current behind the voltage, thus increasing the current, which means a larger waste of power in other parts of the circuits; a rectified alternating current may prove to be well adapted for arc lamps owing to the pulsating character of the current.

New Incandescent Lamp.—Some crude tests of the "Quanonne" lamp, recently placed on the market by a Belgian firm, are published in the Lond. "Elec. Rev.," Oct. 26; in comparison with an ordinary incandescent lamp of 16-cp, the watts per candle were 2.43 as compared with 3.42 for the ordinary incandescent lamp; the question of durability remains to be determined, but judging from the appearance of the filament when working somewhat above the normal voltage, they do not appear to be overrun, and therefore should last a considerable time without blackening or any serious deterioration.

Electric Light for Photography.—In a short lecture by Mr. Kennedy, abstracted in the Lond. "Elec. Rev.," Oct. 26, he compares a forced incandescent lamp with the arc lamp and finds that the cost of the former would be about $1.25 per hour, while the arc lamp, as made by an English firm, would cost but 35 cents per hour; furthermore on account of the blackening of the incandescent lamp, a photographer can never count on absolutely the same light, which is not the case with the arc lamp.

Theatre Arc Lamp.—The Krueger lamp, intended to replace the calcium light, is illustrated and described briefly in the Lond. "Elec. Rev.," Oct. 26.

Shades.—Different patterns of plume shades representing different flowers, are illustrated in the Lond. "Elec. Eng.," Oct. 26; they are made of feathers of various styles and colors surrounding the incandescent lamps in the form of a shade.

Silvering Bulbs.—A recipe is published in the "Elek. Anz.," Oct. 21.

ELECTRIC RAILWAYS.

Three-wire System on Trolley Lines.—The system is editorially discussed in the "Elek. Zeit.," Oct. 25, the advantages are recognized and it is thought that the reason why it is not in use more than it is, is doubtless that its application is limited chiefly to double track roads and that one or the other of the trolley wires must be connected to the positive pole of the generator, which involves a more rapid deterioration of the trolley wire.

Canal Boat Traction.—"L'Ind. Elec.," Oct. 25, states that the recent experiments made with the Galliot system (described in the Digest, Nov. 3), in which the propeller is secured to the rudder, were very successful, both when run with accumulators and when run from a trolley line; the speed is greater and more regular and the cost of operation is less than with the older methods.

Accumulator Traction in Mines.—The Lond. "Elec.," Oct. 26, abstracts briefly a paper from the French by Mr. Libert, in which he describes two interesting applications of accumulators for underground haulage in two Belgian mines.

Overhead Railway.—The Lond. "Elec. Rev.," Oct 26, refers to the Haulon system, described in The Electrical World, and calls attention to difficulties which would arise; it is claimed that the difficulties in crossings and switching will involve considerable more work and expense than might at first appear; no one of the new ideas and resurrections is "presented in a carefully considered form that can stand any real criticism as a going concern."

Liverpool Railway.—An article is begun in the Lond. "Elec. Rev.," Oct. 26, based apparently on the recent papers of Messrs. Greathead, Fox & Parker, and the discussion thereon; these papers and the discussion have been abstracted at some length in the Digest.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Electricity in Mining.—An article by Mr. Berthon is begun in "L'Elec.," Oct. 20; he gives a brief description of the installation at the Decizes mines, in which diphase currents are used, the motors being on the same type as the generators; the starting is said to involve no difficulties. He then discusses in general the best selections of the central station, the lines and the motors; he recommends among other things, high speed direct coupled engines; the voltage should not exceed 5,000, while 250 is preferable for certain kinds of machines; the continuous current can be used in mines in which there is no fire damp, while in the latter polyphase currents or safety motors are absolutely necessary; diphase currents are specially well applicable, synchronous motors for pumps, ventilators, etc., and non-synchronous motors for machines requiring to be started and stopped frequently, while continuous currents transformed from the diphase currents can be used for traction; for all transportable apparatus the voltage should not exceed 100. Under the heading of motors he says the sparking at the commutator has been shown to cause explosions if the commutator itself is warm; he describes a system in which the motor is completely enclosed, but the quantity of air enclosed is too great and an explosion may follow; in another method only the armature is enclosed; in another, illustrated with a diagram, the face of the commutator is made the inside surface of the segments, the brush extending from near the shaft out toward the inside surface of the commutators, the whole space being then enclosed with a joint impermeable to the flame of the fire damp; experiments with explosive gases have given satisfactory results; the only absolute safeguard is to use polyphase currents, the ideal motor being one in which the armature consists simply of a mass of iron, having no connection with the circuit.

Train Lighting.—The Lond. "Elec.," Oct. 26, gives the conclusions to which the General Electric Company of Berlin, have come regarding the simplest solution of the problem, which consists in the use of accumulators pure and simple; the system is used on one of the Government railways of Prussia about 60 miles long. A battery capable of supplying 5 lamps of 5-cp for 40 hours would weigh 467 lbs. if discharged at 15 volts, 516 lbs. at 22.5 volts and 591 lbs. at 30 volts; the capacity should have a reserve of about 10 per cent or more; as a rule 22.5 volts, requiring 12 cells, will answer best and at this voltage a battery for 5 lamps of 16-cp for 8, 12 or 16 hours, would weigh 443, 516 and 562 lbs. respectively; the cells are placed in cases not too heavy to be managed by one man; as regards comparative weights they state that a gas plant for 5 jets of 40 hours, weighs about 1,000 lbs., while the equivalent electric plant with a battery of 12 cells, weighs only 640 lbs.; they recommend changing the cells instead of charging them in place on cars; the state of the battery is indicated by voltmeters or by the simple Aubert hour-counter, but then only when the current is constant. A system in which the accumulators are carried on a separate truck is in use on some Danish and Swedish lines; as regards the cost it is stated that on the German line it is not any greater than for the illumination by gas.

Central Stations.—A recent lecture by Mr. Oscar V. Miller is abstracted in the "Elek. Anz.," Oct. 25. From experience based on 30 stations he obtains the following general data, of use in the original designing of central stations: for every hundred meters of length of street, he finds that one can count on about 30 lamps of 16-cp for the original station and 60 for a station subsequently enlarged and a power consumption of 2 to 10-hp per 1,000 inhabitants. Whether the alternating or continuous current should be used can only be decided for each case separately; incandescent lights will burn equally well with both, and for arc lights the difference is very slight; continuous current lamps are better for streets and open spaces, while the alternating current lamps are better for internal illumination; alternating current motors are as good and in some cases better than continuous current motors; the use of accumulators involves a saving of 15 per cent. in the fuel.

Central Stations in Paris.—"L'Ind. Elec.," publishes periodically very complete statistical and descriptive information regarding the central stations in Paris and France. The greater part of the issue for Oct. 25, is devoted to such information regarding the central stations in Paris brought up to date. It includes a large double page map of Paris and three double page tables.

Central Stations.—An interesting comparative summary of a number of prominent stations in Europe outside of France, is given by Mr. Miron in "L'Ind. Elec.," Oct. 25; similar information is given for each station for comparisons.

Central and Private Stations.—The "Elek. Zeit.," Oct. 25, publishes a paper by Dr. Rasch in reply to the recently made criticism mentioned in the Digest last week. He discusses the relative importance of central stations and separate installations and gives statistics for a number of cities in Germany; he concludes that the gas motor does not take the part in electric lighting that has been claimed; also that under certain circumstances a private installation may be more economical than a connection with a central station, but that this is by no means general and the criticism is therefore unfounded.

Switchboard.—A description by Mr. Mueller of the switchboard used at the Budapest installation is published with very good illustrations in the "Elek. Zeit.," Oct. 25; it will be remembered that this station contains three two-phase alternators of 400-hp, the current from which is transformed at secondary stations into a continuous current, part of which is used for accumulators.

Choking Coils vs. Resistances.—Mr. Rankin Kennedy, in the Lond. 'Elec. Rev.," Oct. 26, announces himself as decidedly averse to the use of alternating currents for public supply; he shows that the advantage of choking coils over resistances, to the consumer, depends entirely on where the choking coil is inserted; if placed on the consumer's side of the meter the choking coil saves nothing more to the consumer than a resistance does, but the supply company gains enormously, as the energy is saved to them; unless it is placed on the supplier's side of the meter and that meter is an alternating energy meter and not a current meter like the Schallenberger, the saving will not be registered in the meter; if a current meter is used a choking coil saves nothing to the consumer no matter where it is placed; the consumer is safe in using a transformer, by which he secures any savings for himself.

Phase Regulation.—In a communication by Mr. Stort to the "Elek. Zeit.," Oct. 25, he states that Prof. Ferraris was the first to indicate the use of phase indicators; in his famous paper published in 1887 to 1888 he stated that if a light cylinder of copper is placed inside of two coils at right angles to each other so that it fills the hollow space almost entirely, and if it has a bifilar suspension, it will form a very sensitive instrument, even with weak currents, for measuring the phase difference; a reference to the original publication is given.

A translation of the article of Mr. Imhoff, abstracted in the Digest, Oct. 13, is published with the illustrations, in the Lond. "Elec. Rev.," Oct. 26.

Disposal of Town and Other Refuse.—A paper by Mr. Deas, read before the Sanitary Institute at Berlin, is reprinted in full with a large number of illustrations, in the Lond. "Elec. Eng.," Oct. 26.

Governing of Steam Engines when Coupled with Dynamos.—A second article by Mr. Addenbrooke is published in the Lond. "Elec.," Oct. 26.

WIRES, WIRING AND CONDUITS.

Wire Gauge—The English journals of Oct. 26 describe and illustrate an ingenious and simple wire gauge consisting essentially of a round disk placed eccentrically in a circular apperture of slightly larger diameter in another disk, thus leaving a crescent-shaped space between them and forming the equivalent of a wire gauge consisting of two straight edges making a small angle with each other; the two similar halves of this crescent-shaped opening, and the two sides of the gauge are taken advantage of by having engraved on them eight different scales which, together with a double scale, gives the equivalent of nine scales each of which gives some information about the wire, such as the size, resistance, weight, current capacity, etc.; except for very important purposes it dispenses with reference to tables.

Submarine Cables of the World.—A supplement of 40 pages to the "Journal Telegraphique," Oct. 25, gives classified, tabulated data regarding all the submarine cables of the world; the tables give the end stations, the date of laying, the number of conductors in each section, the length of cable and wire, the nature of the management and occasionally some remarks; it is doubtless the most complete table of its kind ever published.

Submarine Cable.—The system of S. Thompson for increasing the mutual induction between the lead and its return, is illustrated in "L'Eclairage Elec.," Oct. 13; the two insulated wires are wound with a band of iron, after which they are covered with insulation and an armor; it is said that this increases considerably the rapidity of the signals to be transmitted.

Fuses for Alternating Currents.—The fact that fuse wires blow more frequently for alternating than for continuous currents is thought by the "Elek. Zeit.," Oct. 25, to be due to the fact that screws and other connections are more apt to become loose with alternating than with direct currents.

Stoneware Conduits.—An illustrated description of the Doulton conduit adopted by several of the London companies, is given in the Lond. "Elec. Eng.," Oct. 26; it is a sectional conduit made of stoneware casings containing three ducts.

Electrolysis of Water Mains.—The Lond. "Elec. Eng.," Oct. 26, reprints the report of Mr. Benzenberg at the recent Convention of the American Waterworks Association.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Microphone Induction Coils.—A new method of winding and connecting is illustrated and described in the "Elek. Anz.," Oct. 21; it is claimed that the action of the coil is thereby utilized more completely; with smaller dimensions and lower resistances these coils will have a more powerful action, as both the windings are in the same circuit and assist each other mutually; there will be no perceptible consumption at the microphone contacts, as the extra current in the primary is discharged through the line; it appears to consist of a single coil, a few turns of which form the primary, while all the turns form the secondary.

Pacific Cable.—The Lond. "Elec. Rev.,' Oct. 26, states that according to the "Times," the British Government tried to negotiate with the Hawaiian authorities for the purchase of Neckar Island as a landing place, but a San Francisco despatch states that it was not successful as the reciprocity treaty between the United States and Hawaii prevents the latter from conceding any of its territory to Great Britain.

Telegraphy in Queensland.—A report for 1893 is abstracted briefly in the Lond. "Elec. Rev.," Oct. 26.

Harmonic Call Bells.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Bagnold states that the bell described recently by Mr. Mott in The Electrical World, would not ring and would make only an unpleasant noise; to make it ring one of the pole pieces must be removed; this seems to prove that a bell does not vibrate in two ellipses.

ELECTRO-CHEMISTRY.

Spongy Lead in Primary Batteries.—In an article by Mr. Darrieus in "L'Elec.," Oct. 13, he discusses the use of spongy lead in place of the zinc and gives the results of experiments. In the Daniell cell the E. M. F. is 0.64 volt, but the discharge is remarkably constant for even a very rapid discharge; the internal resistance does not vary very appreciably during the discharge, as the product of the reaction does not form a soluble salt which would change the concentration, and therefore the resistance of the liquids; it possesses the same fault as the zinc form, in that copper deposits on the spongy lead when the battery is not in use, causing a very rapid fall in the E. M. F. A cell made of a plate of lead and another one of spongy lead, both in sulphuric acid, gave an E. M. F. of 0.46 volt, the spongy lead being the negative plate, and therefore the more oxidizable one. Using spongy lead in the bichromate cell, in a porous cup containing sulphuric acid, the E. M. F. was 1.42 volts; the voltage is nearly constant during the discharge, but not as much so as in the Daniell cell. When used in the Bunsen cell the E. M. F. was 1.32 volts and the constancy of the voltage of the discharge was nearly absolute. In conclusion, he states that it is a mistake to say that the negative electrode in a cell must be a soluble electrode, as in none of these is the lead dissolved; such cells are applicable in laboratories where constancy in the discharge is important; such spongy lead plates may be formed by pasting a lead plate with oxide or some salt of lead and reducing with zinc in acidulated water; they may be regenerated by reducing with zinc in the same way.

Lead Dust Accumulator.—The Lond. "Elec. Rev.," Oct. 26, refers briefly to this accumulator made by the Gelnhausen Company; the active mass consists of mechanically prepared lead dust and neutral substances of a porous structure; it is claimed that the large quantity of the neutral, porous substance mixed with the lead prevents the particles of lead peroxide from forming closed strata; it is thought that the oxidation and reduction of the active mass will be effected more completely and rapidly by the penetration and more rapid action of the gases than in the much denser active material of electrodes consisting exclusively of lead compounds.

Chloride Accumulator.—According to the Lond. "Elec. Rev.," Oct. 26, the first mention of chloride of lead and chloride of zinc was made in a patent to Marchenay and that Mr. Payen, although a Frenchman, did not patent his process in France.

MISCELLANEOUS.

Practical Application of Ozone.—An abstract of a paper by Dr. Froelich is published in the "Elek. Zeit.," Oct. 18; it deals with the practical and possible applications, which are briefly as follows: In sterilizing, if the liquid contains oxidizable substances besides the bacilli, the ozone will first oxidize the former, and it can, therefore, be applied to advantage only if the liquid is tolerably free from such substances; the destruction of the bacilli is instantaneous and includes all those which have been experimented with, such as those of cholera, typhus, and in general those causing disease. For ventilation it has been shown that the bacilli in the air and on the walls are only affected in a slight degree, and the application in hospitals is therefore not practical; in the application to the air in theaters, halls, etc., it is stated that the artificially ozonized air is quite different from that in a forest, and it has a decided odor, such that the application in the above cases would hardly be agreeable; effective ventilation, however, can be obtained if the ozone is mixed with volatile oils, giving a pleasant odor. Experiments with the destruction of the phylloxera vastatrix on grapevines have, in general, given unsatisfactory results when the ozone was forced into the earth around the roots, but when applied to the plant 93 per cent. of the pyhlloxera were destroyed. In the application to the ageing of spirits, results showed that light and acid wines were effected but little, while sweet, heavy wines and cordials were altered very considerably; the best application is a moderate one, but repeated often. Application to tobacco and coffee gave favorable results, especially with the coffee when it contained some beans having a bad odor, and which ordinarily may spoil a whole shipment of coffee, with the application of ozone their effect is totally destroyed; it also increases the taste and odor of the coffee, but diminishes its clearness; favorable results were also obtained with new tobacco, but it can hardly be considered a commercial application. An entirely new application, although not yet practicable commercially, is the production of nitric acid from air; he has succeeded in developing a new process, a description of which is promised. The application to the ageing of wood, particularly for pianos, in 12 to 14 hours, has been in successful use for some years. The oxidization of linseed oil is accomplished in a few days. The application to the bleaching of linen is described at some length and it is claimed that their process has been the only effective one, and that the time required is only one-third as great as that required for bleaching in the sun. The application to starch and its derivatives, which is said to be the most important technical application of ozone, is described at some length; it is especially applicable to the production of pure derivatives of starch from the ordinary quality especially from potato starch.

Electricity in Aeronautics.—In replying to the editorial in the Lond. "Elec. Rev.," abstracted in the Digest, Oct. 27, Mr. Maxim, in the issue of Oct. 12, describes his experiments briefly and states that it is yet to be demonstrated that an electric motor can be built which is as light as his steam engine; he considered the matter thoroughly and found that any form of electric motor was quite out of the question on account of the great weight; if wires were used and if the machine traveled at the rate of 40 miles an hour, a few seconds would suffice to have a large amount of cable in the air; besides, a machine attached to the earth by a cable cannot be considered a flying machine; he has constructed a machine which will lift its own full weight, including a motor and 2,000 pounds besides.

Electric Power in Engineering Works.—A presidential address by Mr. Richardson is published in full in the Lond. "Elec. Eng.," and almost in full in the Lond. "Elec.," Oct. 19. He gives some interesting illustrations of the application of electrical driving machinery in a factory; he considers chiefly the application to existing works as distinguished from new works and discusses the economy that can be expected from substituting for scattered engines supplied from one set of boilers, electric motors supplied with current from a central source; also whether the results justify the expenditure. He considers two factories of about equal driving power, one having an electric installation and the other steam; an illustration of the former is the National Arms factory in Belgium, which is driven entirely by electric motors aggregating 500-hp, and in which the motors drive lines of shafting only, the installation being said to be the most complete of its kind in the world; he describes this in detail, giving data; he then gives a description and tabulated data of an old established marine engine works of about the same power and finds that the consumption of coal would be about 36 tons per day, while for the electric plant it would be 13 tons; besides the economy in coal there will be a reduction in the price of the labor, which, for stoking alone, would be about one-half; pulleys; a table gives the loss in per cent. for driving the shafting, belts, pulleys, etc., an average for which is about 50 per cent.; in one case cited this loss was 75.6 per cent. He mentions also an installation at the Bedson Wire Company, in which all the machines are driven separately by electric motors and which is said to be the most perfect and most complete of this kind in that country. From his comparison he concludes that the saving gained by the substitution of electrical driving in an old established works would be considerable. In an editorial mentioned in the Lond. "Elec." it is thought that the use of motors for driving each of various shops would probably be the most suited for existing shops, while the more thorough system of driving each tool with a separate motor, might be more economical to adopt when an entirely new factory is to be erected; each particular case, however, must be judged according to its individual conditions.

Electricity as a Motive Power.—The Lond. "Elec. Eng.," Oct. 26, begins a reprint of the discusssion of the paper by Mr. Selby-Bigge (see Digest, Sept. 15). In this discussion, Mr. Charlton describes at some length the plaut at Pitkin, Colorado, and that at Bodie, California. Mr. Richards discusses some remarks regarding engines.

Self-regulating Pump.—A pump driven by an electric motor operated by a device actuated by a float in the reservoir tank, is described and illustrated in the "Elek. Anz.," Oct. 25.

Submarine Detector.—Mr. Duncan, in the Lond. "Elec. Rev.," Oct. 26, states that the report of the successful use of an electric submarine detector in the search for the sunken Russian ironclad, as published in the English journals and in The Electrical World, Nov. 3, has since proved to be unfounded; the apparatus was out of order and gave signals without due cause; the divers did not descend and did not find the vessel; nothing was found and the experiments have been abandoned to be continued next spring, using a "magnetic inclinator."

Current Indicator.—A simple device is described and illustated in "L'Elec.," Oct. 20; it is for use chiefly in arc lighting circuits to show where the current is flowing; it consists of a coil with a vertical movable core, which operates a red or white signal, according to its position in the coil.

Automatic Steering Compass.—An Academy paper by Mr. Bersier describing his system, mentioned in the Digest, June 2 and Oct. 6, is reprinted in "L'Ind. Elec.," Oct. 25, and "L'Elec.," Oct. 20.

Lightning.—Some recent observations of Prof. Zenger, with three remarkable lightning bolts and their connection with water spouts, are published in "L'Eclairage Elec.," Oct. 13.

Educational.—London "Electricity," Oct. 26, continues the series of the new technical examinations for the British Telegraph department; also notes and examples in electro-technology for the City and Guilds Institute. As these are being continued through successive issues they will not be mentioned again in the Digest The Lond. "Elec. Eng.," Oct. 26, continues the publication of the elementary lectures at the City and Guilds of London Institute. As these lectures form a serial they will not be noticed again in the Digest.

Antwerp Exhibition.—A descriptive article of some length by Mr. Barbier, a considerable portion of which is devoted to the electrical exhibits, is published in the "Memoirs de la Societe des Ingenieurs Civils" for August.

New Books.

MAGNETISCHE KREISE, DEREN THEORIE UND ANWENDUNG. von Dr. H. du Bois (Magnetic Circuits, Their Theory and Application, by Dr. H. du Bois). Berlin: Julius Springer. 1894. 382 pages, 94 illustrations. Price, 10 marks.

This work, which has recently been issued, may be said to be the first large and complete work of a high order devoted exclusively to the subject of magnetism. The name of the author alone would vouch for the fact that the work was of a very high character. As the preface is dated February, 1894, the book is quite up to date, except perhaps in so far that the names of the magnetic units, which are now being introduced in this country, are not used, the consequence of which is that the units are designated merely as C. G. S. units or still more generally, units, leaving it to the context to show which particular unit is meant; it is greatly to be regretted that in such an important treatise the names for the magnetic units are not used, as they might at least have been inserted in parenthesis. The first part is devoted to theory and is similar in its style and character to that in Maxwell's well-known treatise; it is of course highly mathematical in character but will form a very valuable work of reference to the mathematical treatment of the subject of magnetism.

The second part treats of the applications and is of a much more practical character, many parts being within the reach of the educated engineer and constructor. The subject of the magnetic law is, strange to say, included in the second part and not in the first or theoretical part. In this connection an interesting table of analogies is given of similar laws in filtration, diffusion, heat conduction, dielectric polarization, electric conduction and ferro-magnetic induction. A separate chapter is devoted to a practical discussion of the magnetic circuit in dynamos and motors and another one is devoted to transformers. In the chapter on electromagnets and transformers is included a complete description of the author's recent interesting researches with the most powerful fields yet produced.

Although the work is of value chiefly to the more advanced student, and is perhaps invaluable to him, there is much in it that can be appreciated by the practical engineer and constructor. The general appearance of the book is neat and the illustrations are especially clear and well selected, most, if not all of them, it appears, having been made specially for this work.

A Southern Electrical Transmission Plant.

A contract has recently been awarded by the Pelzer Mfg. Company, Pelzer, S. C., for three 1,000-hp 3,500-volt three-phased generators. The generators will be direct connected with three horizontal Victor turbines making 167 revolutions per minute. The dam of the plant is now being built and will be 120 feet wide, giving a fall of 30 feet. The generators are to be used in transmitting power from this fall to a factory which is now being built near the present factory of the Pelzer Company, a distance of 2⅝ miles.

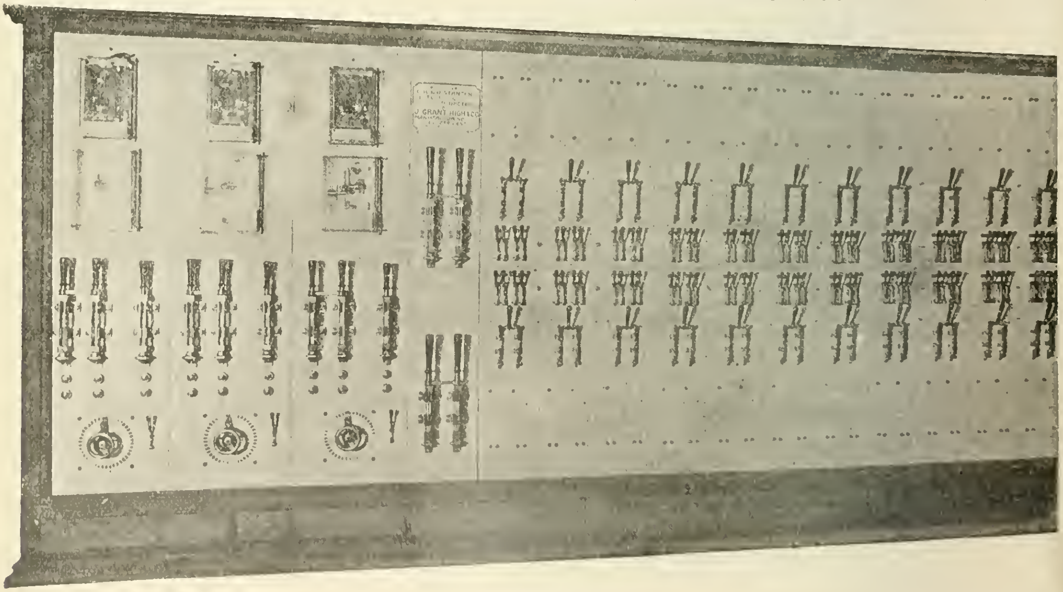
Step-down transformers will lower the voltage to 220 volts and induction motors of the type used in the Columbia Mills, Columbia, S. C., whose electrical plant was recently described in our columns, will be used, ranging in size from 20-hp to 110-hp. One 400-hp synchronous motor will take the place of the Harris-Corliss engine now running the No. 3 Mill, to be fed electrically from the line without the intervention of transformers. The capacity of the present mills is 52,000 spindles, and the new mill being built, 484 feet long and 128 feet wide, will have a capacity of 50,000 spindles.

The reasons for the Pelzer Company adopting electrical transmission were that the present mills are connected with a spur from the railroad, and have all the conveniences of a town. Near the present mills there is a beautiful site for the new mill, and taking into consideration everything—the excessive cost of a mill building at the waterfall on account of excavations, proximity of the railroad spur, the town conveniences, the ability to have the mill practically under one management and in proximity to the mill offices—the company decided to adopt electric transmission.

The installation of this plant is a matter of importance for the South, as it will accelerate the utilization of her numberless water powers, and much credit is due to Messrs. Lockwood, Greene & Co., who are the mill engineers, and to Prof. A. F. McKissick, of the Alabama Polytechnic Institute, Auburn, Ala., the consulting electrical engineer, for their recommendations leading to the adoption of electricity. The contract for the electrical machinery was awarded to the General Electric Company.

A Large Switchboard.

The accompanying illustration shows part of a large switchboard recently built for the Warden Tenement Mill Building, at Nineteenth and Allegheny avenue, Philadelphia, by J. Grant High & Co., 125 North Third street, Philadelphia. This board is made up of slabs of white Italian marble 8' high 1½" thick and 30" long; the slabs are firmly held together and supported from the floor by wrought iron shapes. The back ends and top of the switchboard are enclosed in a cupboard made of hard wood finished in oil and rubbed down. The back ends consist of doors with panels throughout; the doors are hung on brass butts and furnished with brass Yale locks, so that all parts of the board may be rendered visible and accessible to the engineer at any time for the purpose of making adjustments and repairs. On the lighting end of the board, of which only a part is shown in the cut, are mounted 34 150-ampere D. P. switches and 146 auxiliary switches for fusing with 2 1,500-ampere switches for feeders. On the dynamo end of the board are 3 Westinghouse ammeters and 3 Westinghouse volt-meters. On the bottom of the dynamo board are mounted 3 rheostats of the Carpenter style with flush face, and in the centre of the board are 6 700-ampere switches and 3 S. P. and 3 D. P. and 3 small 30-ampere S. P. switches. On the back of the door are mounted 3 sets of copper bus bars and connections, weighing in all nearly 2,500 lbs.



A Large Switchboard.

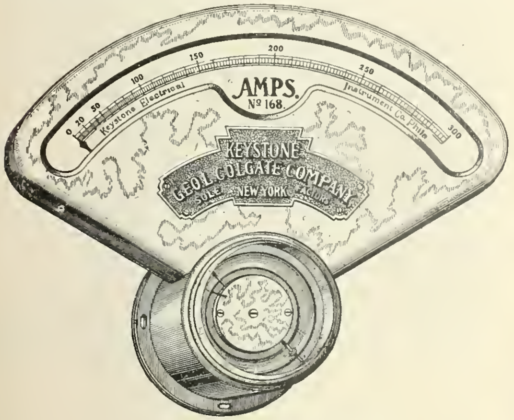
The Keystone Ammeter.

The accompanying illustration shows an ammeter, made by the Keystone Electrical Instrument Company, of Philadelphia, for which The George L. Colgate Company, of this city, is sole agent.

These instruments, which are known as "Type K," contain no permanent magnets or springs and are therefore not liable to deterioration. All moving parts are mounted in jewel bearings and the case is thoroughly dust-proof. The voltmeters are of high resistance, thus requiring a minimum amount of current and may be left in circuit continuously without affecting the readings. There is also said to be an entire absence of magnetic lag and no heating error. All moving parts are magnetically shielded so that the effect of external magnetism is not appreciable.

The scales in the instruments are large, with generous divisions and so arranged that within the limits of the scale, readings may be obtained to about 1-5 of the division points marked.

The instruments are very easy to set in position on switchboards, the only requirement being that they shall be plumb. This is easily accomplished by seeing that the needle points to zero when no current is



TYPE "K" KEYSTONE AMMETER.

flowing through the instruments. The holes in the flange of the case to receive the screws which fasten the instrument to the board, are slotted to allow the adjustment to be made after the instrument has been placed, or to adjust it in case the switchboard should get out of level.

Each instrument after calibration, is sealed in such a manner that it is impossible to inspect the moving parts without breaking the seal. A calibration card accompanies each instrument shipped, giving the number of instrument, certifying to the correctness of calibration at a given temperature and, in the case of a voltmeter, the resistance of the coil is also stated.

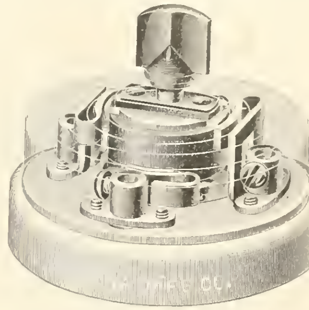
Iona Specialties.

The Iona Manufacturing Company, Boston, of which J. Jones & Son, 67 Cortlandt street, New York, are agents, have recently brought out several interesting specialties, several of which we illustrate herewith. The new Iona snap switch consists of the necessary number of contact springs somewhat in form like cotter pins, but shorter, one end being stationary, and the other loose, the latter making the connecting points. This spring is punched out, into a long strip with a piece attached to one side and end, which finally forms the base of the screw post, upon which the post is mounted, and also the means of attaching the whole to the base. The spring made in this form is strong, also elastic, and makes a good, firm contact point.

The operating mechanism consists of a ratchet, permanently attached to the base, a round disc, having a shaft hole off center, with a projecting finger which stands against the ratchet teeth, a shaft carrying a small eccentric disc, fitted into the shaft hole in a large round disc carrying the projecting finger, above which is the connecting bar, held down by a spiral spring, and in position by a second projecting finger of the round disc, coming up through a hole in its surface. The spiral spring mentioned is attached permanently to the top of the shaft, its loose and lower end lying normally against a third finger on the round disc, and exerting sufficient pressure to hold the lower projecting finger of the round disc firmly against one of the ratchet teeth. In operating, the small eccentric disc throws the large round disc outward, until the lower projecting finger is released from the ratchet tooth which it has been resting against, when the spring, that in the meantime has been creating a greater pressure on the round disc through the turning of the handle, tending to wind it up, throws the contact bar forward and makes or breaks circuit, as the case may be.

The movement is quick and positive, the break is long and the contact large. All the parts are strong and made for wear. The spring is of a special steel wire. The desire has been to overcome in it the faults to be found with most of the switches now on the market. Another good point is that the position of the handles shows whether current is on or off.

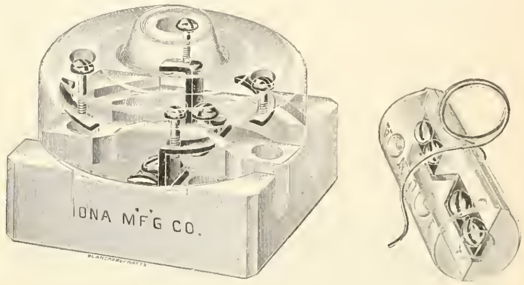
In connection with these switches, the Iona Company manufactures a porcelain block for setting them on, with abundant room for leading in



DOUBLE POLE SWITCH.

the wires in a neat manner, especially in connection with moulding cleat work.

In porcelain goods among the many new specialties recently brought out is a combination cut-out, the cover of which is securely fastened by one turn of the screw-driver, and with the cap will take in cord of



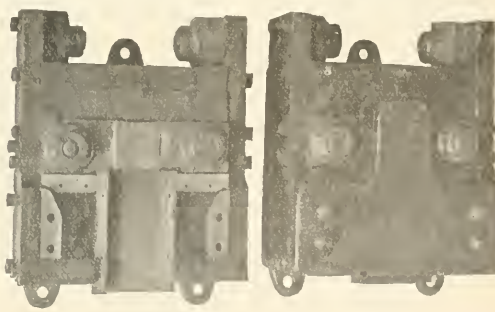
COMBINATION AND "BUG" CUT-OUTS.

double the ordinary size used. The cut-out can be used for cleat, concealed or moulded work, though specially intended for the latter.

The little porcelain covered bug cut-out shown in the accompanying cut is also meeting with much favor among the fixture men and others requiring a single pole cut-out to go in a small space and meet the requirements of the underwriters.

Magnetic Blow-out Fuses.

An interesting experiment was recently made at the Kent avenue station of the Brooklyn City Railroad Co. to test the efficiency of the magetic blow-out principle in the fuse carriers which form part of the



MAGNETIC BLOW-OUT FUSE CARRIERS.

General Electric Company's generator equipments. Previous to the test there had been, on the part of the railroad company, no little skepticism as to the value of the magnetic blow-out principle, and the test was made with the view primarily of proving the correctness of the claims of the manufacturing company, that the apparatus would cope with almost any demand made upon it.

The test was made on the company's dock behind the station, under

the supervision of Mr. Walter A. Pearson, Superintendent of the station. Six water rheostats of large capacity were connected into the circuit in series in order to regulate the load and the conductors were brought directly from two of the four 1,500-kw. multipolar generators. The fuse blew at 4,400 amperes at 550 volts, an equivalent in horse power of 3,243 hp. The result of the test was a complete demonstration of the efficiency of the magnetic blow-out on a very powerful and destructive arc. The cut shows the blown fuse and one of similar capacity intact. It will be seen that the action of the magnetic blow-out must have been

FUSE INTACT AND BLOWN.

.nstantaneous, and, perhaps, the most remarkable feature is the small amount of metal blown.

The magnetic blow-out principle is a special characteristic of all apparatus manufactured by the General Electric Company which has to deal with possible arcs. It is successfully embodied in the well-known K-car controller as well as in the lightning arresters, fuse-boxes, etc. It is claimed to be the only known method of preventing destructive arcing.

A Cincinnati Electrical Enterprise.

Cincinnati has long been recognized as one of the most favored cities in the Union for manufacturing facilities. In geographical location,

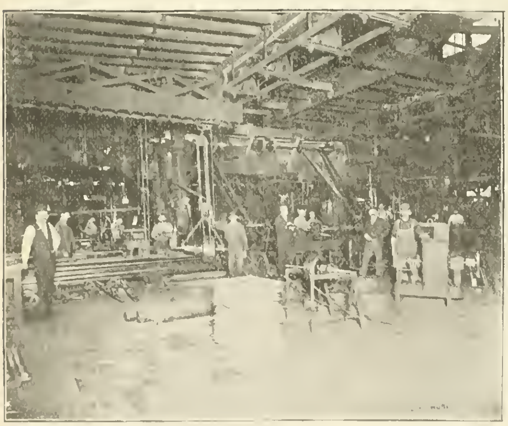


FIG. 1.—MAIN FLOOR.

it is the center of a wide section of country, while the cost of obtaining coal and iron is enormously low as compared with many other localities. These facts have led to the establishment of scores of manufacturing plants, particularly in the line of machinery, engines, etc. Now it bids fair to become a great electrical center.

One of the latest candidates in this field of work is the Triumph Electric Company, whose headquarters and factory are at South Second street. The outside appearance of the building is characteristic of Cincinnati factories, very unostentatious, but once inside, the visitor is surprised to find one of the best equipped electrical factories in the country. The machines are of the finest grade and of every description necessary to the production of electrical apparatus. Fig. 1 gives a good view of the main floor. This room is about 200 feet long and 350 deep, one-half being devoted to the assembling and finishing of dynamos and motors, while the remainder is given to the machinery. The illustration shows quite a number of workmen busy with their various occupations, but this gives no idea of the force in the employ of the company. Fig. 2 shows the winding department on the second floor, where most of the repair work is done. This feature of the Triumph Company's work is one of especial importance, it having contracts with some of the largest electrical enterprises in Cincinnati, one being the Cincinnati Edison Company.

The product of this factory, having been introduced in many sections of the country, has many features of interest. The dynamo is known as "The Triumph," and is especially designed to meet the demand for a distinctly low-priced dynamo. That there is such a demand no one questions, and "The Triumph" aims to fill the bill, being at the same time within all the electrical and mechanical requirements. Its particular feature is its magnetically enclosed armature. The advantages claimed for this type are great strength, short magnetic circuit, no external magnetism, brushes set without lead and great efficiency.

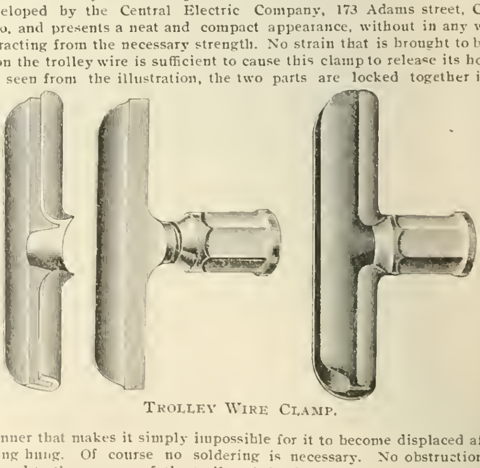
J. C. Hobart, who is secretary and superintendent of the company, and practically the one who called it into existence, is a very young man but one destined to make his mark. Graduating from the Massachusetts Institute of Technology, as a mechanical engineer, he for a long

FIG. 2.—WINDING DEPARTMENT.

time devoted himelf especially to mechanical engineering. When the Triumph Compound Company was started, Mr. Hobart became the ruling spirit of the enterprise and was still connected with it when he perfected the electrical apparatus now manufactured under his supervision. In this latter work he has many advantages over purely electrical engineers, because he has a most thorough practical knowledge of the mechanical requirements of electrical apparatus, and to his knowledge in this respect is in a large measure due the success of the "Triumph" dynamo.

New Trolley Wire Clamp.

A new trolley wire clamp, illustrated herewith, has recently been developed by the Central Electric Company, 173 Adams street, Chicago, and presents a neat and compact appearance, without in any way detracting from the necessary strength. No strain that is brought to bear upon the trolley wire is sufficient to cause this clamp to release its hold. As seen from the illustration, the two parts are locked together in a



TROLLEY WIRE CLAMP.

manner that makes it simply impossible for it to become displaced after being hung. Of course no soldering is necessary. No obstruction is offered to the passage of the trolley, it having a perfectly level track to run on, and consequently there is no destructive or wasteful sparking. These clamps are made to fit either a ⅝ or 7-16 in. stud, and are furnished in bronze or malleable iron.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Nov. 10, 18949.

GENERAL ELECTRIC did not fail to take an active part in the boom noted towards the end ot the week in the active stock list. As bas been related, there bas for the past few weeks been a very large short interest not only in this but also in other active stocks, and the tremendous bull argument afforded by the election retnrns has had the effect of effectually scaring the bear crowd into covering their short contracts, to the great appreciation of quotations. General Electric bulls have had additional help afforded them iu their campaigning against the bear enemy in the favorable news relative to large contracts and increasing bnsiness made public recently. One of these reports had to do with a contract for equipping the entire Yerkes street railway system in Chicago. Another to a second announcement tbat President Coffin is one ol the backers of a scheme to consolidate four electrical companies at Toledo, two of which are electric street railway companies, and the General Electric Company will hereafter furnish all supplies for the consolidation, which is capitalized at nearly $5,000,000. A United Press dispatch brings this news from Schenectady: "The managers of the General Electric Company have advertised for plans and specifications for two new buildings to add to their extensive plant in this city. When the bids have been examined and accepted the contract will be let at once for the erection of the structures with all reasonable expedition. These new buildings will be a storehouse, 350x52 feet, and a laboratory. Their construction not only adds to the capacity and facilities ot the works, but it shows especially that the Edison General Electric plant is here to stay. The recent determination to send some motor work to the shops at Lynn is in accordance with the purpose not to overload the works here, bnt to have an annex, as it were, for extra special work whenever the latter too much taxes the capacity of the main shops and force engaged in this city." From this it may be inferred that the General Electric Company is bnsy these days. In fact, an official is quoted as saying that it now has 85 per cent. of the business in electrical supplies, and that the company's prospects are steadily improving. Notwithstanding keen competition, the company is more than holding its own, and is making a profit on its sales—a profit admittedly small, bnt sufficient, according to official statements, to not only pay the dividend on the preferred, but even leaving something over for the common stock. Of course, no payments ot this character can be ordered for some time, as no action has yet been taken regarding a reduction of the capitalization to make good the impairment, and nothing will be done in this direction tor some time. In the meantime the company will pay off as quickly as possible the outstanding guaranties and endorsements, which at present aggregate but $135,000. With its other surplus funds the company will continue to retire its debenture bonds. General Electric has now cash on hand amounting to $770,000, inclnding, however, $250,000 for conpons due next December. Altogether there is a more hopeful feeling among the managers of the company, as they feel certain that General Electric's future is now assured.

WESTINGHOUSE ELECTRIC issnes have been too quiet to reflect by increasing quotations the prevailing improved business situation. It may be, too, that new litigation into which the Westinghouse Company was plunged during the past week may have interfered with any advance. One of these suits has to do with an injunction brought by the United States Electric Light Company—this is the concern which absorbed the old Weston Company, extended the plant, and was in turn merged with the Westinghouse Company—preventing the Westinghouse people from moving machinery ont of the Newark shop. Another suit which came up this week for a bearing before the United States Circuit Court in Boston has to do with the claim of William Stanley, Jr., that certain patents secured from him by the Westinghouse Company were procured by fraud. The company's officials refnse to discuss the case otherwise than to say that they do not anticipate any but a favorable outcome ol the litigation. The wide currency given to the matter may, however, have stopped speculation in the company's stock issues for the time being, but the officials seem not to be concerned about this.

THE AMERICAN DISTRICT TELEGRAPH COMPANY'S board of directors, as intimated last week, met, but postponed action on the dividend now due, "owing," it was stated, "to the lack of a quorum". This practically amounts to the passing of the dividend at the present moment; but this has been discounted in the speculation, and quotations fail to show much change.

WESTERN UNION TELEGRAPH has been weak at odd times on long selling of stock. The adoption ol a constitutional amendment in New York State forbidding race track betting, among other forms of gambling, is expected to seriously curtail the revenues of the Western Union Company. This occasioned some selling ont of investment holdings, which was accelerated by professional sales of the stock on the reports of the serious crippling by storms of the company's New England lines. All in all, however, the stock bas held pretty steady during the past week.

THE STREET RAILWAY & ILLUMINATING PROPERTIES trustees have purchased more preferred stock, cancelling 764 sbares at an average price of 100.75, a good advance over the last price paid. All in all, a total of 17,107 shares has been retired to date.

AMERICAN BELL TELEPHONE continues weakish. The storms throughout the Eastern section of the country did large damage to its wires, the long distance telephone service being chiefly demoralized. The loss to the company will be heavy, and is aggravated by the interference with business. This loss of revenne and the likelihood that 10,000 new shares will come upon the stock market as a result of the special stockholders' meeting on the 15th inst., have been the chief factors causing the selling of long stock noticeable this week.

ERIE TELEPHONE STOCK fails to display much life on the New York Stock Exchange. A report for the quarter ended September 30, made public this week, shows that the Erie Company received in dividends on its holdings of the stocks of the three sub companies $61,587, or $2,227 more than in 1893. It paid out in dividends $48,000, the same as last year, so that it has a surplus of $13,587, or a gain of $1,957. For the nine months ended September 30 there is a surplus, after paying dividends, ot $35,080, a gain of $2,740 over the same period in 1893.

THE STANDARD UNDERGROUND CABLE COMPANY, of Pittsburg, now that the claim against the United Electric Light & Power Company, of New York, bas been paid in cash, bonds and stocks to an amonnt materially in excess of the original indehtedness, is in splendid financial shape. Those well posted concerning the company's affairs state that it will increase its dividend rate in January. It now pays 6 per cent. per annum, or 1½ per cent. quarterly.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	100½	101½
" " " Brooklyn	100	110	112
" " " Boston	100	120	128
Chicago Edison Company	100	120	130
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	12	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	2¾
General Electric	100	37⅞	38
General Electric, pref	100	65	70
Interior Condnit & Ins. Co.	100	20	30
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref	50	52	53

BONDS.

Edison Electric Ill., New York	1,000	107¼	107¾
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	90	91

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	198
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
Central & South American Telegraph	100	101½	105
Commercial Cables	100	125	145
Erie Telephone	100	52	54
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
*New England Telephone	100	67	69
Postal Telegraph-Cable	100	54	60
Western Union Telegraph	100	89	89¼

* Ex-div.

NEW INCORPORATIONS.

THE COALPORT-IRVONA LIGHT, HEAT & POWER COMPANY, capital stock $10,000, has been incorporated by R. A. Holden and others.

THE RIVER TELEPHONE LINE, Tomahawk, Wis., capital stock $2,000, has been incorporated by W. H. Bradley, John Landers and A. H. Woodworth.

THE LAKE GEORGE IMPROVEMENT COMPANY, Lake George, N. Y., capital stock $1,000, has been incorporated to operate a telephone line bordering on Lake George.

THE SALINA TELEPHONE COMPANY, Salina, Kan., capital stock $10,000, has been formed to construct and operate a line of telephones in Salina and throughout the county.

THE WILDER-SLOSS ELECTRIC HOTEL CALL COMPANY, Chicago, Ill., capital stock $250,000, has been incorporated by Louis Stein, Augustus Binswonger and Edward R. Wilder.

THE UNION TELEPHONE COMPANY, Parkersburg, W. Va., capital stock $150,000, has been formed by C. H. Shattnck, E. M. Gilkeson, Romuey; J. B. Finley, Parsons, and F. B. Sherrick, Marietta.

THE DAYTON LONG DISTANCE TELEPHONE COMPANY, Dayton, O., has been incorporated by J. C. Patterson, J. P. Breene, Gov. J. B. Thomas, Prof. E. T. Brewster, W. H. Shank, W. M. Whitemore and James E. Cronin.

THE PEOPLE'S ELECTRIC COMPANY, Valparaiso, Ind., capital stock $30,000, has been formed to maintain a light, heat and power plant, etc. The interested parties are George M. Willis, Otis E. Turner and James A. Cummins.

THE CLEVELAND & ELYRIA ELECTRIC RAILROAD COMPANY, Columbus, O., capital stock $200,000, has been incorporated by F. T. Pomeroy M. A. Sprague, A. W. Bishop, C. W. D. Miller, Leon M. Boe, Will Christey and A. H. Pomeroy.

THE FOREST CITY ELECTRIC LIGHT AND POWER COMPANY, Forest City, Ia., capital stock $25,000, has been incorporated to operate an electric light and power plant. M. Barton, C. H. Kellogg and J. P. Thompson, Forest City, are interested.

THE UNITED TRACTION COMPANY, Pottsville, Pa., capital stock $10,000, has been incorporated by Charles H. Barritt, Wayne; Wm. A. Barritt, Jr., St. Davids; and John F. Finney, Pottsville, Pa., for supplying motive power to passenger railways, etc.

THE CANTON MUTUAL TELEPHONE COMPANY, Canton, O., capital stock $10,000, has been incorporated by F. D. McKelvey, Joseph A. Linville, B. N. Winings, H. E. McKelvey and George McKelvey, for the purpose of carrying on a telephone business.

THE TRADERS' ANNEX COMPANY, Clarksburg, W.Va., maximum capital stock $1,000,000, has been formed to erect and own buildings, etc., and to construct electric plants, street railways, etc. T. M. Jackson, D. R. Morgan and W. B. Maxwell, Clarksburg, W. Va., are interested.

THE AMERICAN IRON CAR COMPANY, New York, minimum capital stock $5,000, has been incorporated to manufacture and construct passenger, freight, and electric railway cars, etc. The promoters are Carroll Sprigg, Q. A. Gates, Henry Briderman and E. L. Pierson, all of New York City.

THE NORMANDY GOLD MINE, Amador City, Cal., maximum capital stock $100,000, has been formed to manufacture and mine, lease, etc., and to operate water works, electric plants, tramways, etc. Stephen H. Emmens, Chas. A. Week, L. G. Haskin, all of Amador City, are the interested parties.

THE BELDING ELECTRIC ALARM MAIL BOX COMPANY, Chicago, Ill., capital stock $25,000, has been formed to manufacture and sell the electric alarm mail box patented by E. C. T. Belding, and improvements thereon. E. C. T. Belding, T. W. Saunders and C. Stuart Beattie, are the promoters.

THE MOTHER LODE POWER COMPANY, San Francisco, Cal., capital stock $800,000, has been formed to generate and deal in electricity for light, heat and power; compressed air, steam; to own water works, etc. deal in mines, etc. The promoters are J. F. Parks, Jackson; Jackson Dennis, Sutter Creek, and Chas. D. Pierce, Oakland Cal.

THE DELAWARE AND SCHUYLKILL TRACTION COMPANY, Doylestown, Pa., capital stock $50,000, has been formed to construct and operate motors, cables or other machinery for supplying motive power to passenger railways. Wm. Jenks Fell, Faulkland, Del.; Robt. G. Fulton and Samuel A. Hamilton, Philadelphia, Pa., are the promoters.

THE MONARCH GAS ENGINE MANUFACTURING COMPANY, San Francisco, Cal., capital stock $20,000, has been formed to manufacture and deal in gas, gasoline, electric machinery, steam engines and accessories, and to operate a general machine shop. J. A. Frost, Oakland, W. S. Scott and S. W. Powell, San Francisco, Cal., are the promoters.

McKEES ROCKS, PA.—An ordinance granting rights of way and other privileges to the Phoenix Electric Light Company has been passed by the Borough Council and the company will at once go ahead with the building of a plant that will have a capacity for not only lighting the streets but for the purpose of supplying private consumers. The incorporators are R. L. Townley, W. S. McLain, Jr., H. C. Johnson and J. E. Heinzman.

Special Correspondence.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, November 10, 1894.

IN THE NOTE last week of the New England agency of the Buckeye Engine Company, in referring to its large plant at the Hadley Company, Holyoke, Mass., the triple expansion engine in use at their plant should have been stated as of 1,000-hp, instead of 100.

MR. E. W. HOWARD, formerly connected with the Westinghouse Electric Company at Pittsburg, has purchased the electrical department of the H. C. Fish Machine Company, of Worcester, Mass. It is the intention of Mr Howard to manufacture larger types of dynamos and motors than has been the custom of the company to manufacture, constructing both four-pole and bi-pole machines.

MR. CHARLES G. CHASE, president of the Mason Regulator Company, of Boston, and who has occupied a prominent position, business-wise and socially, in that city for nearly forty years, died suddenly last Thursday, November 8, on his way from his office to his home in Brookline. Mr. Chase was highly esteemed by all who had the pleasure of his acquaintance. In extending our sympathies to Mr. Walter G. Chase, his son, treasurer of the Mason Regulator Company, we feel confident we are voicing also for the electrical fraternity generally, in which he has a wide acquaintance.

CAPTAIN BROPHY, our old and esteemed friend, who has been both a chief of a fire department and an insurance inspector, has been interviewed by the Boston Herald. Boston, justly or unjustly (the latter as it seems to us), has obtained a popular reputation for having more fires than she ought, and bigger ones, and the papers that delight in displayed headlines generally have it "It was thought" to have been caused, by an electric light wire. Captain Brophy is in favor of the plan of extinguishing these fires by utilizing the inexhaustible supply of salt water at the very doors of Boston, in the absence of any proper and sufficient gravity system. Large and powerful pumping engines could then furnish high pressure to any part of the city, and until the Atlantic dries up there would be no fear of shortness of supply

SEVERE TOUCH OF WINTER visited Boston on the 5th and 6th insts., before its time. Rain, followed by heavy, wet, clinging snow and low temperature, caused much trouble and inconvenience with overhead wires, and the advocates of an underground system were furnished with a fresh repetition of the argument. Mr. Commissioner Murphy and his staff are hard at work in the direction of getting the first section complete within the prescribed time. The conduits themselves are practically completed, and the larger portion of the work now remaining to be done is the drawing in of the conductors and arranging for the distribution to stores, hotels, residences, etc. from the underground system, which will be effected from the man-holes for the present in all probability. The masses of congealed rain and snow on the wires presented a beautiful sight to the eye of the beholder, but to an electric light or railroad man the beauty was all in his eye, for he knew it meant trouble and a good many hours of hard work

MR. SAMUEL G. STINESS, superintendent of the Pawtucket (R. I.) Gas & Electric Company, whose unfortunate and horrible death occurred last Monday, November 5, at the railroad crossing in that city by being crushed under a train of cars, was one of Pawtucket's most prominent citizens, prominent in both the gas and electrical industries, having been for over thirty years identified with the former and one of the earliest among gas managers to advocate a recognition and affiliation with the latter. He occupied deserved conspicuousness in the New England Gas Association, and was one of the founders of the New England Guild of Gas Managers and the American Gas Light Association. He was prominent in Masonry, and in the business and social walks of life had hosts of friends who will deeply regret his death. His funeral occurred Thursday, November 8, and was largely attended, quite a number of the electrical fraternity from Boston being in attendance. Mr. Stiness left a widow and two sons, both prominent young men.

Canadian Notes.

Ottawa, Nov. 8, 1894.

TORONTO.—The gross earnings of the Street Railway Company for the ten months of 1894 amounted to $803,377.

TORONTO.—The largest engine ever manufactured in Canada for generating electricity was put in motion this week at the power-house of the Toronto Railway Company. It cost $50,000, and is of 1,200 horse power.

TORONTO, ONT.—Two applications have been received by the York Township Council from parties wishing to supply electric light, heat and power within York Township. One was from John W. Moyes, the other was from F. J. Dunbar.

NIAGARA FALLS. Ex-Mayor Manning, R. F. Segsworth, William Kyle and other Toronto men are asking a bonus of $75,000 from the Council at Niagara Falls, Ont., to build an electric railway from the Falls to Drummondville and Queenstown.

OTTAWA, ONT.—There are now in process of incubation in the Ottawa district three electric railway schemes of considerable importance. These are, first, the proposal to connect Ottawa and Brookville by electric road, the Hull and Aylmer scheme, and the Buckingham project.

BROCKVILLE, ONT.—The impending rate war between the Bell Telephone Company, and the Dundas Telephone Company, in Dundas County will likely be called off. It is said that a deal is being arranged whereby the plant of the new company will be taken over by the Bell Company.

ST. CATHERINES, ONT.—The Point Abino Street Railway Company is applying for a charter to construct a street railway in the municipalities of Bertie, Humberstone and Wainfleet, and the villages of Fort Erie and Port Colborne, in the County of Welland, the amount of capital stock of the company to be $100,000.

ST. CATHERINE'S.—Notice is given that application will be made by the Municipal Corporation of the City of St. Catherine's and the St. Catherine's and Niagara Central Railway Company to the Legislative Assembly of Ontario, next session for an act to carry into effect certain proposed arrangements between the petitioners.

OTTAWA, ONT.—The Bell Telephone Company has taken possession of its new buildings. The cables enter the basement from the underground ducts, and embrace 2,800 wires, carrying nearly 1,100 subscribers. The capacity of these underground ducts is 7,200 wires. The length of duct now laid is 47,811 feet, while there are 1,025 miles of wire now in use in the city.

NIAGARA FALLS, ONT.—Notice is given that application will be made at the next session of the legislature of Ontario for an act to incorporate the Toronto, Hamilton & Niagara Falls Electric Railway Company, with power to construct an electric railway from Toronto to Hamilton, thence to the Niagara river at or near Niagara Falls; and also a branch line from the village of Grimsby to Smithville and Dunville.

MONTREAL.—A taxpayer in this city asks the following questions of the City Council: "I see that a contract has just been given by the city of Toronto for the lighting of the city at $72.82½ per light. Is it true that the city of Montreal has been paying $130 for a similar service? If so, why? Say 1,000 lights in Montreal cost $130 each, $130,000; in Toronto, 1,000 lamps at $72.82½, $72,825; annual loss, $57,175; annual loss to taxpayers for ten years, $521,750."

QUEBEC.—Hon. P. L. Pelletier, Hon. Phillippe Landry, J. J. Fremont, M. P.; P. B. Dumoulin, banker; Barnard Leonard, John U. Gregory and Ernest Pacaud, are applying to the Legislature to be incorporated under the name of the Quebec City and District Electric Railway Company, with power to build and run electric railways in the city of Quebec, and also in the counties of Quebec, Portneuf, Montmorency, Levis, Bellechasse, Dorchester, Beauce and Lotbiniere.

HAMILTON.—Application will be made at the next session of the Legislature of Ontario, for an Act to incorporate "The Hamilton and Lake Erie Power Company" with power to acquire the right of way for and construct a water course and raceway from some point on Lake Erie, through the city of Hamilton to Burlington Bay, through the counties of Haldimand, Lincoln, Welland and Wentworth, and to build electrical works in connection with the said water courses and raceway for the purpose of generating electrical energy.

YARMOUTH, N. S.—Notice is given of the application to the Dominion Government for charters to confer power for building and operating electric railways between Yarmouth and New Brunswick. E. Franklin Clements, the applicant, says the idea is to follow the main line of travel from Yarmouth, skirting the shore to Weymouth, thence to Truro, Amherst, and into St. John, New Brunswick. Water power, and in many instances—by means of patented appliances—the tidal waters are to be utilized. The cost of travel, it is claimed, will be fifty per cent. less than on any existing roads.

THE STOCK OF THE MONTREAL STREET RAILWAY COMPANY is gradually going into the hands of investors. Over one thousand shares of the old stock has recently been taken over; 600 by the Society of Jesus of Montreal; 300 by John Breaken, Quebec; and 100 by E. J. Barbeau, Montreal; besides several other smaller lots. James Ross is now the largest individual shareholder in the company, having no less than 6,000 shares to his name, representing over half a million dollars at present market prices. R. B. Angus has 2,500 shares, the Seminary of Montreal 2,000 shares, and Mr. Breaken of Quebec, over 1,000 shares.

OSHAWA, ONT.—Capt. Carter, whose charter for the construction of the Electric Street Railway has lapsed, is after a new charter. He appeared before the City Council and proposed to go on now and commence the construction of the road within ten days, and place a deposit of $2,000 to the credit of Mayor Cowan in the Western Bank here on that date, to be forfeited should the first section be not completed by May 31, but to be returned should the first section be completed and in operation by January 1, 1895. It was decided to further consider the matter at a special meeting of the Council, to be held on Tuesday, 13th inst.

THE EXCHEQUER COURT of Ottawa, has given judgment for the government in the case of the Toronto Street Railway vs. the Crown. This was a custom case arising out of the importation of rails for street railway purposes. At different times in 1891, 1892 and 1893 the Toronto Railway Company imported steel rails weighing 69 pounds per lineal yard to be used in relaying and extending its tracks. On such importations there were paid customs duties (under protest) amounting to $56,000. Action was taken for the recovery of such amount from the Crown. The chief question in the case was "Does the term 'railway' in clause or item 173 of the Tariff Act of 1887, which provides for the free entry of steel rails, weighing not less than 25 pounds per lineal yard for use in railway tracks, include a street railway?" Mr. Justice Burbridge, in the course of a carefully considered and exhaustive judgment, answers this question in the negative. He gives judgment for the Crown with costs.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, Nov. 2, 1894.

HOUSE WIRING.—The competition for house wiring contracts is extremely keen in this country, every bell hanger, plumber or gas fitter can, by the expenditure of a little paint, add to his already numerous qualifications that of electrical engineer. It would seem that the severity of this competition is being increased by the cable manufacturing companies entering into the field, much to the disgust of the regular house-wiring firms. Several of our electrical supply companies when they first started business tried the experiment of going in for wiring, but whatever may have been the immediate profit or advantage to themselves, they were soon induced to desist.

CITY LIGHTING.—I hear on good authority that the recent breakdown at the Bankside station of the City of London Electric Lighting Company resulted in a very stormy meeting of the board of directors, and that the contractors concered are likely to have a warm time of it. A daily paper had a paragraph with regard to this breakdown which threw the blame upon the cables, and insinuated that the contract for these had been obtained by improper influence. The outcome of this paragraph is that writs for libel are flying about in all directions. It is in the "City" that the incandescent gas burner is likely to obtain its foremost hold, and it is just in this area that the electric light has of late been misbehaving itself.

News of the Week.

TELEGRAPH AND TELEPHONE.

ABERDEEN, MISS.—J. Herman Soock, Jr., will erect a telephone system, and is in the market for supplies.

CEDARTOWN, GA.—The American Magneto Telephone Company, of Kokomo, Ind., is to construct a telephone system, having obtained a franchise for same.

ELIZABETH, N. J.—The Elizabeth Mutual Telephone Company was organized, and the following directors were elected: F. M. Voorhees, J. M. Grooff, Peter Egenolf, E. R. Brown, George C. Ford and others. The company will at once advertise for bids and the construction of the line through the city will be begun.

MARIETTA, O.—Articles of association have been filed with the secretary of State of West Virginia for a charter for the Union Telephone Company, C. H. Shattuck, president Citizens' National Bank, Parkersburg, W. Va.; G. A. Gilkerson, Internal Revenue Collector; Hon. J. B. Finley, of Parkersburg; A. T Nye, president Citizens' National Bank, and F. S. Shurick, of Marietta, being charter members. Franchises are held in these two cities, and subscribers on five-year contract include practically all the present subscribers of the Bell Company in these two cities. It is expected work will begin on plant at once, and everything will be in as complete order as it is possible to make the same. The make of telephone has not yet been decided upon.

ELECTRIC LIGHT AND POWER.

BUNKER HILL, ILL.—Plans are being perfected for an electric light plant.

FREDERICTON, MD.—Address the Mayor concerning electric lighting contract about to be let.

OSWEGO, N. Y.—The question of municipal ownership of an electric light plant is being agitated.

MARION, O.—The Marion Electric Light and Power Company reports an increase of capital stock from $40,000 to $100,000.

WINTER PARK, FLA.—The Summit Hotel has purchased a 25-kw combined engine and dynamo from the General Electric Company.

LEBANON, ORE.—Lebanon is likely to vote on the question of bonding the town for the purchase of the electric light company's plant.

WILLIAMSPORT, PA.—The Beacon Electric Company has received a contract for lighting the streets of the city. J. Geo. Kaelber is manager.

READING, PA.—At a meeting of the Board of Trade, Mr. Brusher moved that $400,000 be borrowed for a municipal gas and electric light plant.

DULUTH, MINN.—The citizens have voted to issue $600,000 in bonds for the purchase and improvement of the electric plant already in existence.

WILLOUGHBY, O.—Willoughby will vote on the proposition to construct at public expense an electric light plant; $6,000 is the amount asked for.

HACKENSACK, N. J.—The plant of the Edison Electric Light Company has been destroyed by fire. Loss, $30,000. The company will rebuild at once.

WARNELL, FLA.—The Warnell Lumber & Veneer Company, manufacturers of vegetable crates, orange boxes and veneer, will put in an electric light plant.

DETROIT, MICH.—The contract for lighting West Branch with electric lights has been awarded to the Vaughn Manufacturing Company, and the town will have electric lights at once.

DELAND, FLA.—John B. Stetson, of Philadelphia, is organizing a company with a capital stock of $300,000, for the purpose of building an electric light plant, railway and ice plant.

NORTHPORT, L. I., N. Y.—The Northport Electric Light Company is trying to secure a suitable site on which to establish its plant. The people have been promised light by January 1st.

EAST LIVERPOOL, O.—The Ceramic City electric light plant was completely destroyed by fire. The cause was suddenly increased pressure of gas which supplied the boilers. Loss $10,000.

SPRINGFIELD, MASS.—William Boardman Toby and several other prominent electricians have formed a company with a capital stock of $150,000 for the manufacture of motors and other electrical machinery, on which patents are held by Pittsfield inventors.

DAYTONA, FLA.—A company is now considering the capitalization of a combined electric plant to operate a street railway, light the streets and manufacture ice and provide cold storage at Daytona.

PLAINFIELD, N. J.—The North Plainfield Borough Council, being dissatisfied with the quality of its street electric lighting, has decided to employ an expert to investigate the company's alleged deficiencies.

BUFFALO, N. Y.—The LeRoy Hydraulic Electric Company has been granted permission to string wires and erect poles for transmitting electricity for light, heat and power on streets where there are no poles.

PORTLAND, ME.—At the electric light works all the valuable machinery was deluged with water, so that the loss will be $50,000, and perhaps more. The company gives out an estimation of the loss as about $100,000.

RICHMOND, VA.—The Chesapeake and Ohio will build an electric light plant at Richmond, Va., to supply its storage batteries, which are used on its passenger trains for lighting and which are proving a geat success.

CONNEAUT, O.—The Council has entered into a contract with the Conneaut Electric Lighting Company for twenty-five 1,500-cp arc lights, to be erected in different parts of the town. It also passed an ordinance compelling all railroads to erect arc lights at street crossings.

YOUNGSTOWN, O.—The Mahoning county commissioners are talking of putting in an independent electric lighting plant for the court house and jail. It costs at present $528 per year to do this work. They claim an outfit can be had for $1,000 to do the same work more satisfactorily.

BALTIMORE, MD.—A company is being organized to utilize the waters of the Susquehanna River to provide electric power. The plant, it is said, will be established at Coniwingo, 35 miles from Baltimore, from which it will be transmitted by overhead wires, taking in several towns on the way.

NEWTON, MASS.—The question of municipal ownership of a gas and electric lighting plant is being agitated. Mr. Goodrich, of the Newton & Watertown Gaslight Company, is prepared to establish a plant in Newton, and to undertake to do the whole of the street lighting by the incandescent system.

WORCESTER, MASS.—The Trustees of the Home for Aged Women have decided on plans for their new building, which will be lighted probably by electricity. The building committee consists of Augustus N. Currier, C. Henry Hutchins, George C. Whitney, Francis A. Gaskill and Edward F. Tolman.

RYE NECK, N. Y.—A meeting of the property owners to consider the lighting question has been held, and it was decided to petition the town board to make a contract with the Mamaroneck Electric Light Company for 20 or 25 incandescent lights at $18 a light per year. The matter will come up before the town board.

SIOUX RAPIDS, IOWA.—H. D. Smith has closed a contract with the Fort Wayne Electric Corporation, through its Omaha agent, Mr. E. T. Pardee, for a 500-light Fort Wayne alternating dynamo, together with 300-light capacity of the new "Wood" transformer. The plant is to be installed in Mr. Smith's new mill in connection with a new Reynolds-Corliss engine.

LISBON, IOWA.—The city has closed a contract for the new municipal electric lighting plant. The Fort Wayne Electric Corporation through its western agent, Mr. E. T Pardee, of Omaha, gets the contract for a 750 light "Wood" alternator, with the complete electrical construction, and the Buckeye Engine Company, of Salem, Ohio, through their Chicago agent, Mr. H. E. Troutman, got the contract for the steam plant, including a 75-hp Buckeye engine. Work will be commenced at once.

RICHMOND, VA.—Messrs. Wallerstein and Grimes of the committee, and Mr. Maurice W. Thomas, representing the Old Dominion Electrical Construction Company, recently held a meeting. It was suggested by the committtee that Mr. Thomas submit at the next meeting a detailed estimate as to the cost of establishing an electric light plant, with water power or steam power. This was agreed to. Mr. Thomas stated that the city of Lynchburg intended to establish an electric plant of their own, and that he had to appear there to submit estimates to the proper authorities.

THE ELECTRIC RAILWAY.

ATLANTA, GA.—The Atlanta Traction Company will extend its lines to the city property.

CHARLESTON, S. C.—The City Council has granted J. Fishburn a franchise to build and operate an electric railroad.

NEW ORLEANS, LA.—The New Orleans Traction Company intends building an electric power plaot which is to cost $50,000.

TAMPA, FLA.—R. W. Easley and W. H. Kendrick are arranging to build an electric railway between Tampa and Palmetto Beach.

KANSAS CITY, MO.—The Broadway horse car line of the Metropolitan Street Railway Company will be changed to electricity.

CHICOPEE, MASS.—The Municipal Board has appointed a committee to draw up a franchise for the Holyoke Street Railway Company.

NEW BRITAIN, CONN.—The Central & Electric Railway Company has now fully decided to extend their lines to Hartford and Berlin.

SPRINGFIELD, MASS.—A location for tracks on Bond street has been granted the Street Railway Company. It will start to build at once.

MIDDLETOWN, CONN.—The civil engineers are laying out the lines for the electric railway. They have progressed as far as College street.

OGDENSBURG, N. Y.—The Ogdensburg Street Railway Company has made application to the common council for the operation of its system by electric power.

HENDERSON, KY.—J. N. Alsop, of Owensboro, and others have secured control of the Henderson street railway and propose changing to electric power.

NASHVILLE, TENN.—The Nashville Electric Railway Company's car sheds were recently burned. The property was valued at $20,000, and was partially insured.

BROOKLYN, N. Y.—The Nassau Electric Railway Company, of Brooklyn, is to construct a power station 102x150 feet, which will be built entirely of iron and steel.

LINCOLN, ILL.—The Lincoln Street Railway has been sold for $75,000. Possession will be given at once and an extension of the line will be commenced immediately.

OCONAMOWOC, WIS.—An ordinance is before the Council to grant an electric street railway franchise. Thomas Marston, of the firm of Felix & Marston, Chicago, Ill., is the leading projector.

ATHENS, GA—Aoplication has been made for a charter by the Athens Electric Railway Company for the purpose of operating the Athens Electric Railway, of which T. P. Hunnicutt, is superintendent.

LIGONIER, PA.—The people of Ligonier Valley are much interested in the proposed extension of the electric road to Ligonier. From there to Latrobe, 10 miles, the only outlet is the Ligonier Valley Railroad.

HEMPSTEAD, L. I., N. Y.—The board of trustees held a special meeting to consider the application of the Hempstead Traction Company for a franchise for a surface railway in certain streets in the village.

M'KEESPORT, PA.—An electric road to connect Elizabeth and McKeesport is contemplated. It is also intimated that it may be a new company altogether that is seeking to build the proposed line to Elizabeth.

AKRON, O.—The Akron and Bedford and Cleveland Electric Railway Company has been granted a franchise by the County Commissioners, and work will be commenced April 1. The road is to be completed within one year.

ST. LOUIS, MO.—The City Council and House will be asked soon to grant a franchise to the St. Louis & Southwestern Electric Railway, of which George C. Fox is president, A. E. Weiss, secretary, and J. M. Wiener treasurer.

MIDDLETOWN, N. Y.—At the meeting of the Goshen Board of Trustees a franchise was granted to the Middletown-Goshen Traction Company to lay its tracks through certain streets within the corporate limits of the city.

WESTBORO, MASS.—The Woodville, Hopkinton & Westboro Electric Railway Company is being organized by D. G. Underwood, of Malden, and A. M. Bridgman, of Brockton, Mass. It is stated that $50,000 has been subscribed.

PARKERSBURG W. VA.—W. A. McCosh, superintendent of the Park City Street Railway, has men at work on Seventh street digging holes for the trolley poles for the new electric street railway This is the first step towards the erection of the new line.

LOS ANGELES, CAL.—Prof. T. S. C. Lowe, builder of Pasadena's Mountain Railway, is interested in the extension of the road from Echo Mountain, its present terminus, to the highest summit of Mount Lowe. The extension will be an electric road seven miles in length.

GLOUCESTER, MASS.—The new electric street railway between Gloucester and Beverly will be built, perhaps next spring. The directors are securing the consent of Gloucester and Essex end and with the consent of Beverly and Manchester will be in condition to begin early in the spirng.

WOODVILLE, MASS.—An electric railway is projected between Woodville Hopkinton and Westboro, and $50,000 of the stock has been subscribed. G. B. Underwood, of Malden, and Arthur M. Bridgeman, of Brockton, heavy subscribers to the Marlboro & Westboro line, are interested in the new road.

CINCINNATI, O.—Plans for the foundation of a new generating station, projected by the Cincinnati Street Railway Company, were filed with the Inspector of Buildings. The plant is to be a very large one, designed to furnish power for the operation of the new line on Hamilton avenue to College Hill.

RUTLAND, VT.—The extension of the fair ground branch of the electric street railroad through "Nebraska" by way of the Pine street tunnel will not be built until next spring. It is stated on good authority that estimates are being made for the extension of the West Rutland line to Lake Bomoseen.

NORTH ADAMS, N. Y.—The electric street railway from North Adams to Williamstown through Braytonville, Greylock and Blackinton, seems to be an assured thing, work to commence early next spring. The Hoosac Valley Street Railway Company, backed by strong local capitalists, will build and operate the road.

READING, PA—Efforts are being made to build an electric railroad from Reading to Allentown. The various supervisors of the township through which the road is to be built have been approached. It is said that it is to be an extension of the Reading & Temple Electric Railway and is to enter Allentown on Walnut street.

EAST BOSTON, MASS.—R. W. McIntyre, of New Haven, Conn., has been awarded the contract for the construction of the new terminal facilities, of the Boston, Revere Beach and Lynn railroad at East Boston. The work will include building new freight house, docks, ferry houses, electric coal pocket, etc., and cost over $100,000.

AKRON, O.—The County Commissioners granted the Akron, Bedford & Cleveland Electric Railway a franchise allowing the use of the Bedford pike for railroad purposes. The company is to keep bridges and culverts in repair and pay the county $300 annually for tweny-five years. It is expected that work will be commenced on the line at once.

PIKESVILLE, PA.—Geo. R. Webb, vice-president and manager of the Pikesville & Emory Grove Electric Railroad Company, and J.M. Widderdorf, banker, were in Hanover to consult business men concerning the extension of the road to Hanover. Mr. Webb says it the people along the line between Hanover and Manchester will raise $150,000 the road will be built.

CHAMBERSBURG, PA., is agitating for a trolley line and public park. But $20,000 more is needed to start the enterprise. Among contemplated extensions and spurs are a line to Fayetteville, Mount Alto and Waynesboro with a proposed extension to the Blue Mountain summer resorts, an extension through the streets of town and a spur to the C. V. R. R. passenger station.

JERSEY CITY, N. J.—The Consolidated Traction Company wants to extend its West Avenue line down to Greenville. It is making arrangements to do this. President E. F. C. Young, General Manager David Young, Mr. John Crimmins and other officials of the Consolidated Traction Company and the New Jersey Central Railroad Company, have made visits to West Bergen and thoroughly examined the ground.

MILTON, ONT.—The Hamilton Radial Railway Company, William F. Forsythe, president, bought out the Niagara Central Railway for $400,000. The Hamilton Radial Company will extend its lines thirteen miles from Niagara Falls to St. Catherines, the first part of its radial system. Surveyors are at work on the line between this city and St. Catherines. The first work will be to build the road into this city.

EUREKA SPRINGS, ARK. It is stated that surveys will soon be commenced under the direction of F. L. Hamilton, of Harrison, Ark., for building the proposed electrical railway from Eureka Springs via Green Forest to Harrison. The distance is forty-five miles, and two bridges, one 204 feet and the other 504, will be required. A syndicate of Chicago capitalists, with Dr. E. C. Harris as manager, is said to be back of the project.

BEREA, O.—The Cleveland & Elyria Electric Railroad Company, with headquarters at Berea, filed articles of incorporation. The route of the proposed road is from Cleveland through the counties of Cuyahoga and Lorain to Elyria, with branches to Wellington and Oberlin. The capital is $2,000,000, and the incorporators are E. T. Pomeroy, M. A. Sprague, A. W. Bishop, C. W. D. Miller, W. M. Cole, Will Christy and A. H. Pomeroy.

COLUMBUS, GA.—The Columbus Railway Company, Mr. Furnoy president, has closed a contract with the Philadelphia Railway Construction Company for the electrical equipment of its road. The equipment is to consist of twenty 200-kw generators, 20 G. E-800 motors forming 10 double equipments with Form K. controllers. The line equipment is for 14½ miles single track and 2½ miles double track. General Electric apparatus will be used.

JACKSONVILLE, FLA.—J. H. Sherman, as chairman, has received from Geo. W. Haines, superintendent of the Jacksonville Street Railway Company, a reply to a petition of the residents of West Campbelltown, West Brooklyn and West Louisville, asking that the street railroad be extended through Myrtle avenue into the suburbs named. Mr. Haines says that he cannot give a definite answer at present, as the matter of extension of the service is being now arranged.

LINCOLN, ILL.—Mr. W. H. Patterson, manager of the street railway lines of Bloomington, Ill., has purchased the lines at Lincoln, paying $75,000 for the same. The Bloomington company has taken possession of the property, and one of the first things it intends to do is to greatly improve the system. At present there are six miles of railway in the city, and Mr. Patterson will make it a belt line, with a 15-minute service. Mr. Lewis Senseney, now connected with the lines here, will be made manager.

HAMILTON, ONT.—The Hamilton Electric Radial Railway, Wm. F. Forsyth, president, has bought out the Niagara Central Railway for $400,000, to be paid to Dr. Oille, Mr. Sylvester Neelon and the other owners of the road. The Hamilton Radial Company will make the 13 miles of road from Niagara Falls to St. Catharines, the first part of its radial system. Mr. Forsyth started a lot of surveyors on the line between this city and St. Catherines. The first work will be to build the road in this city.

MILTON, N. Y.—At a meeting of the Highway Commissioners a petition by Fred R. Barnes was read, asking the Board to grant a franchise for the construction of an electric road through the public highways of the town from this village to Rock City Falls. Another petition from S. C. Medbury and Herbert C. Westcot was read, asking the Board to grant them a franchise over the same route. Mr. Barnes appeared for the construction company. The Board decided to grant the franchise to Mr. Barnes.

MUNCIE, IND.—The Citizens' Street Railway Company has in the past ten days added one mile additional trackage to its lines. Another additional half mile is now being constructed, making in all over sixteen miles of trackage. The power capacity of the road has been increased one-third in the past thirty days, making the line one of the best equipped in the country for a city of 25,000 population, and all has been built and constructed in the period of eighteen months from the date of driving the first spike. Over one and three-quarters miles of this trackage is laid with 86-lb. Johnson's improved groove rail in asphalt streets, which has been laid and streets made in the past sixty-five days.

Miscellaneous Notes

THE GENERAL ELECTRIC COMPANY has advertised for plans and specifications for two new buildings to add to their extensive plant in Schenectady, for storerooms and laboratory.

THE STANDARD UNDERGROUND CABLE COMPANY has brought suit at Pittsburg against Geo. Westinghouse, Jr., in which it is alleged that certain stock turned over to the latter has not been properly applied, and an order of the court is asked compelling an accounting for the same.

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS will hold its second general meeting at 12 West Thirty-first street, November 15 and 16, and members of the American Institute of Electrical Engineers have been cordially invited to attend. Among the papers to be read of especial interest to electrical engineers is one by S. Dana Greene, Esq., on "Electricity on Shipboard; Its Present position and Future Development." Another paper by Naval Constructor W. J. Baxter, U. S. N., will describe an electrical method by means of which the launching speed of the battle ship "Texas" was determined.

THE PACIFIC CABLE.—On November 9 proposals were opened at Ottawa, Canada, by the Minister of Trade and Commerce, from six different firms for laying a Pacific cable. The firms are the Fowler-Waring Cable Company, the Telegraph Construction and Maintenance Company, Messrs. Siemens Bros., the W. T. Henley Telegraph Works Company, Francis A. Bowen, and the India Rubber Gutta Percha and Telegraph Company, all of London. The propositions were all considered by the Minister as favorable, and as removing every obstacle that has been urged against the enterprise.

SMALL BOYS AND A MOTOR CAR.—Last week, at Newark, N. J., according to a local paper, two small boys, aged about 6 years, "with their several mashes, two little girls," took possession of a vacant motor car, and though the trolley was disconnected and the controller lever had been taken off by the motorman, they nevertheless succeeded in starting up the car. While one youngster put on the trolley the other by means of a piece of shingle inserted in the slot of the controller shaft, turned on the current. As the speed increased, however, the enterprising quartette became frightened and leaped off, and the car finally jumped the track and brought up against a telegraph pole.

Trade and Industrial Notes.

GOVERNMENT CONTRACTS.—The following awards have been made for furnishing the Weather Bureau with telegraph supplies for the fiscal year ending June 30, 1895:

Bishop Gutta Percha Company, New York, 300 feet each, wire, braided, Okonite insulation, Nos. 14, 16, 18, Birmingham gauge, 7-32 insulation, 2¼ cents, 2 cents, 1¼ cents.

The National Electric Manufacturing Company, Milford, Conn., 150 con-

nectors, single, 5 cents each; 15 keys, telegraph, Bunnel pattern, top connections, 95 cents each; 10 ditto, bottom connections, 95 cents each; 15 relays, box soundings, with keys, 150 to 200 ohms, $4.50 each; 20 sounders, telegraph, giant, $1.35 cents each.

The E. S. Greeley & Co., New York, 300 connectors, double, 8½ cents each; 2,500 insulators, screw, glass, 2¾ cents each; 150 pounds sal-ammoniac, 6¾ cents; 50 syringes, battery, hard rubber, No. 6, $1.40 each; 10 vises, hand, 5½ inch, with straps, $1.12½ each; 50 pounds each copper wire, office, Phillips' braided water-proof, Nos. 20 and 22, 23 cents.

W. R. Brixey, New York, 12 rolls tape, Kerite, 57 cents; 1,000 feet copper wire, No. 16, B. W. G., 3 conductor cable, 7½ cents; 1,000 feet ditto, No. 16, B. W. G., 1 conductor cable with braided covering, 2½ cents; 5,000 feet ditto, insulated, 2 conductor, No. 18, B. W. G., 4½ cents; 500 feet ditto, Nos. 16 and 18, B. W. G., 9 conductor cable, 18½ cents; 500 feet ditto, 6 conductor cable, 13 cents.

Royce & Marean, Washington, D. C., 30 batteries complete, Leclanche-Gonda prism, small, with sal-ammoniac, 70 cents each; 30 ditto, large, with sal ammoniac, 70 cents each; 9,000 pounds blue vitriol, packed in barrels, 3¾ cents; 7,000 pounds of blue vitriol, packed in 50-lb. boxes, $1.82 per box; 3,000 brackets, insulator, 2 cents each; 150 brushes, battery, bent handle, 25 cents each; 3,000 coppers, gravity battery, 5x7 inch, 4½ cents each; 600 jars best flint glass, gravity battery, 10 cents each; 50 pliars, Stubs', side cutting, 8-inch, $1.42 each; 60 ditto, 5-inch, 63 cents each; 200 porcelain insulators, No. 4, 1 cent each; 20 switches, wooden base, 2 point, 15 cents each; 50 telephone cords, 15 cents each; 4,000 zincs, crowfoot, for gravity battery, 5x7 inch, 11½ cents each; 75 ditto, for Leclanche-Gonda prism battery, 5 cents each.

FRANK H. STEWART, Philadelphia, importer, manufacturer and dealer in electrical supplies, owing to increase of business, has taken larger quarters at 20 North Seventh street.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., have been awarded the contract for furnishing dynamos for the new Library of Congress building at Washington, the price being $6,400.

THE OAKMAN ELECTRIC COMPANY, 136 Liberty street, is making a special drive in Partridge Carbon Brushes and McNutt incandescent lamps for street railway service, for which it is New York selling agent.

E. G. SMITH, Columbia, Pa., in a 16-page catalogue, describes a line of modern measuring instruments for trades, scientific purposes, etc. Among the specialties are all kinds of calipers and metric scales, screw-micrometers, for laboratories, etc..

S. E. WHITEHEAD, Carthage, Mo., reports an increasing demand for the Eddy self-locking windlass in excess of supply. He has just completed a shipment to Jamestown, N. Y., of one hundred and thirty widlasses and has a large number of inquiries and orders.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is hard at work upon its catalogue of electric railway supplies, and hope to have it ready for distribution in a few weeks. They promise to list a very desirable line of electric railway material, including the "Lynn" specialties.

THE PARTRICK & CARTER COMPANY, 125 South Second street and 131 Gothic street, Philadelphia, are now the sole selling agents for the Applegate electric matting. This matting will hereafter be made in three standard widths, two, two and a half and three feet, each roll being about 50 feet long.

THE SHAWMUT FUSE WIRE COMPANY, 161 High street, Boston, has issued a new edition of its pamphlet on fuse wire and fuse links. Besides being a catalogue, this handsome brochure also partakes of the character of a technical treatise on the subject, and therefore interests everyone who in any way has to do with fuse wire.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., has closed a contract with the city of Lisbon, Iowa, through their Wester nagent, E. T. Pardee, for a municipal lighting plant, consisting of a 750-light Wood alternator, with a complete electrical equipment. Also with H. D. Smith, of Sioux Rapids, Iowa, for a 500-light Fort Wayne alternator, together with 300 light capacity of Wood transformers.

J. B. PHILLIPS, electrical engineer and contractor, 30 Cortlandt street, New York, has recently closed a contract for wiring Troop A Armory, 94th to 95th street, this city, for 1,000 lights. Mr. Phillips has just completed the installation of the Standard Silk Company's plant, of Phillipsburg, N. J.; this contract of 560 lights, Wenstrom dynamo and rearrangement of all the circuits, 1,500 lights in all. Mr. Phillips has moved his office from 40 to 30 Cortlandt street.

THE LINK-BELT MACHINERY COMPANY, 21 South Jefferson street, Chicago, has issued a handsome pamphlet entitled "Modern Methods of Handling Fuel as Practised in Locomotive Coaling Stations, Electric Light and Street Railway Power Plants, etc.," in which a large number of coaling plants installed by this company are illustrated, as well as others in which it has installed the "Standard" water tube safety boiler, rope transmissions, etc.

J. GRANT HIGH & CO., 123 North Third street, Philadelphia, Pa., have just opened up a branch office in Room No. 807 Medinah Temple, Chicago, where they will be pleased to see their patrons, and expect to do an extensive business in their line. This enterprising firm of young men has met with flattering success in the East, where their switchboards particularly have been highly appreciated by electrical engineers and installed in many notable plants.

THE PROCTOR-RAYMOND ELECTRIC COMPANY, Rochester, N. Y., has been having much success with its "Eclipse" and "Rex" bells, and the "Eclipse" annunciator. It is the intention of this enterprising firm to manufacture the most complete line of electric bells and house furnishing electrical goods of any concern in the business. To this end the highest grade of material is used, and such care bestowed in construction and on workmanship that liability of any of the apparatus to get out of adjustment will be impossible.

HOLTZ, FEY & BLOOMER, 630 Mission street, San Francisco, Cal., have succeeded to the firm of Holtz & Fey, Mr. J. G. Bloomer, late manager and for eleven years with the California Electrical Works, being the new member. Mr. Theodore F. Holtz was for ten years superintendent of the factory of the California Electrical Works, with which Mr. Charles Fey was also formerly connected—in the electro-mechanical department. The factory of the new firm has been removed to the above address, where it has also opened a store for a general electrical supply business.

THE PURITY OIL FILTER MANUFACTURING COMPANY, 90 Water street, Pittsburg, Pa., recently received the following orders for oil refiners for electrical plants: From its San Francisco, Cal., sales agent, D. W. Doubs, for 13 Purity and Ideal refiners; Municipal Electric and Water Department, North Attleboro, Mass., one Ideal refiner; Rockville (Conn.) & Ellington Street Railway Company, one Ideal refiner; National Cotton Oil Company, Galveston, Tex., one Ideal refiner; Pittsburg, N. I. & Coraopolis Street Railway Company, one Ideal refiner; James Beegs, New York, one Ideal refiner; Thomson-Houston International Electric Company, New York, four Ideal refiners; Cairo (Mich.) Electrical Works one Ideal refiner; Home Bank Building, Detroit, Mich. one Ideal refiner.

THE BALL ELECTRIC LIGHT COMPANY, of New York, has just installed under the supervision of F. Widmayer, a 65-arc light plant at the leading dry goods store in Pittsburg, Pa., Campbell & Smith, Fifth avenue. The above firm have been using two 2 26-light arc dynamos of the Ball system for the past six or seven years and have lately increasd their plant by a new dynamo. This new dynamo is attracting great attention in Pittsburg, as it is the first of its kind in that locality having a very unique and original method of regulation. It has practically two independent automatic end frames. The regulator is most simple and effective. The machine is fitted up with self-oiling bearings and has all the latest improvements that can be applied to a high tension arc dynamo. Mr. Scobie, the engineer in charge, takes great pleasure in showing this dynamo to all who are interested in arc lighting.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has issued a very complete catalogue of electric street railway supplies, containing no less than 204 large octavo pages, being probably the most exhaustive trade publication devoted to this branch ever printed. The book is a companion volume to its similarly exhaustive catalogue of general electrical supplies, and together furnish an admirable illustration of the enormous extent of the electrical industries. It is needless to say that every imaginable material used in connection with the construction and operation of street railways is here contained, only excepting the power-house and motor car machinery. The entrance of this enterprising firm in the electric railway field is fittingly announced in this manner, and with a wider scope thus opened for its energies it will give a still further impetus to the supply branch of the electrical industries. Another useful publication by the same firm is a pocket catalogue of insulators, which contains handsomely lithographed sheets of every variety of porcelain insulators.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has received a flattering testimonial from H. S. Cooper, general manager of the Schenectady Street Railway Company, in which he states that on May 10 an open-air car was equipped with steel pinions, and on May 28 the same car was equipped with raw hide pinions. On October 6 the steel pinions were worn out and had also worn out the axle gears in which they mesh, while the raw hide pinions are not nearly worn out and the axle gears in which they mesh are not worn at all perceptibly. Both these cars have run steadily over identically the same route and have carried very closely the same number of passengers an average the same mileage, 100 miles per day. The road is a very hard one on gears, as it is all curves and grades, with the curves all on grades 6, 7½, 10 and 12 per cent., and some of them pretty long ones. The writer says he is well pleased with the results, the more especially as he was somewhat dubious at first as to the using of raw hide on single reduction machines, although his experience with them on double reduction had been very satisfactory.

THE GENERAL ELECTRIC COMPANY has secured one of the largest contracts for furnishing motors and generators ever awarded, signed on Nov. 2 by Mr. Charles T. Yerkes, to supply the North Chicago Street Railway Company and the West Side Street Railway Company with electrical power. The contract at the start calls for the delivery on or before March 1, 1895, of 600 motors and 3,600 horse power in generators, at which time Mr. Yerkes expects to have his power house ready to start the different lines. It is the intention of Mr. Yerkes to equip all his traction system in Chicago with electricity, and the contract is said to call for the General Electric Company to supply the same. The present contract amounts to over $500,000, and it will in all probability amount to about $4 000,000 before Mr. Yerkes has completed his system, as he controls virtually all the railroads, both surface and elevated, in Chicago, with the exception of Capt. R. Somers Hayes' West Side Metropolitan Company. The motors and generators will be delivered subject to order, and all the cars equipped with them so as to be ready when the power houses are completed. The General Electric Company has now on its pay roll at Lynn and Schenectady about 4,700 men, and the force will have to be increased considerably to fill the contract, besides other large ones that have been lately secured. During the month of October the General Electric Company sold about 800 motors and generators of different styles, which amounted to about $700,000 in value.

H. D. BAYNE & COMPANY, Mutual Life Building, New York, are among the most recently organized combinations for carrying on the business of consulting engineers and electrical contractors. The technical matters in all work undertaken by the firm will be under the direct personal supervision of Mr. H. D. Bayne himself. His connection with the electrical business dates as far back as the year 1876, and his work then in the employ of the old Jablochkoff company, of Paris, France, brought him into contact with the leading men of their time in electrical matters, such as Jablochkoff and Gramme. Since those days he has had extended experience with the following firms: Jablochkoff Electric Light Company; Ball Electric Light Company; Thomson-Houston Electric Company; United Edison Company and General Electric Company. For these companies he has superintended the construction of apparatus in England, Scotland, Ireland, Spain, France and Belgium; and out of Europe, in the United States, Canada, Mexico, Yucatan, Guatemala, Venezuela and Cuba. Such an unusually wide experience will no doubt be a guarantee of success to the new enterprise in what they propose to make their speciality, viz.: Artistic electric lighting, transmission of power and railroad work. Mr. Bayne is the patentee of several electrical appliances. Mr Bernard Eekhout, son-in-law of Mr. James McNamee, of this city, and late senior of the firm of Eekhout, McLean & Company, of Baltimore, is manager for Mr. Bayne, and will conduct all financial and general business matters of the firm.

Business Notices

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs, doing business at Rochester, N. Y., has been mutually dissolved.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 6, 1894.*

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

528,529. PLUG FOR ESTABLISHING ELECTRICAL CONNECTIONS; C. W. Brown, Montreal, Canada. Application filed January 16, 1894. A plug having a body portion tubular in cross section, to be inserted in a correspondingly shaped socket, and having one or more integral flexible expanders normally projecting beyond the periphery of the tubular body portion.

528,539. RHEOSTAT; J. C. Fyfe, Chicago, Ill. Application filed April 27, 1894. The combination with a stationary support of a wheel or cylindrical aicrupturer arranged to rotate on the support.

528,561. TROLLEY WIRE CLIP; J. W. Perry, Philadelphia, Pa. Application filed May 5, 1894. A wire clip formed in two parts with a wire pocket between them, one part having a tread curved from end to end on the bottom and the other part removably held to the first part so that they will bite the wire between them.

528,566. COMBINED MUNICIPAL TELEGRAPH AND TELEPHONE SYSTEM; H. M. Seitzinger, Wilkesbarre, Pa. Application filed May 2, 1894. This comprises a central station and main line, sub-stations upon separate circuits, a switch to connect the main line with the separate circuits, and an operating lever for the instruments at the sub-station operated by the movement of the switch.

528,589. ELECTRIC BURGLAR ALARM; W. A. Brownell, Boston, and J. B. Seager, Hancock, Mich. Application filed January 31, 1894. This comprises a door, electric circuit, alarm, and two pairs of circuit closers, all being in series in the circuit when in connection, one pair of closers being in the lock and adapted to be connected by the bolt when extended, and the closers of the other pair being respectively on the door and door frame, and adapted to be connected when the door is open or ajar.

528,590. TELEPHONE EXCHANGE SYSTEM; W. Childs, Fort Smith, Arkansas. Application filed May 27, 1890. A switching instrument comprising a series of concentric circular paths, one or more deflecting flanges, a traveling switch and electrical propelling devices to move the switch.

528,591. TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM. W. Childs, Fort Smith, Arkansas. Application filed May 27, 1890. The combination of a revolving electrode switch, a spring to operate against the switch, a ratchet and pawl controlling the spring, and electro-mechanical devices to revolve the switch in a convolute pathway.

28,592. TELEPHONY; F. R. Colvin, New York, N. Y, Application filed July 26, 1894. This comprises a plurality of stations connected in multiple-arc relation to the line, each station being provided with a high potential calling generator and a talking outfit organized to impose on line low potential talking currents.

528,593. RAILWAY SIGNALLING SYSTEM; M. Corrington, New York, N. Y. Application filed December 3, 1891. The combination of a spaced dial, a pointer moving over the same, and a train actuated mechanism for mechanically imparting to the pointer a determinate advance movement successively by the automatic action of each one or more trains in passing beyond a signalling point.

528,615. SWITCH OPERATING MECHANISM FOR HOISTING MACHINERY; A. J. Shaw, Muskegon, Mich. Application filed June 7, 1894. In combination with two independent electrical switches, an operating lever commou o both, and adapted to move both together and either one alone.

528,620. ELECTRIC HOISTING MACHINERY; A. J. Shaw, Muskegon, Mich. Application filed June 25, 1894. In combination with electric hoisting machinery, a magnetic brake for controlling the same, a stop or detent to limit the action of the brake, and an electromagnet included in circuit with the hoisting motor and serving to control the position of the stop or detent.

528 635. MAGNET; Adrian H. Hoyt, Penacook, N. H. Application filed March 14, 1894. A permanent magnet composed of a bar of steel provided with a substantially circular opening and having its magnetic poles at opposite sides of and substantially surrounding the opening.

528,640. TELEPHONE; W. C. Lockwood and J. M. Lockwood, Brooklyn, N. Y. Application filed June 14, 1894. The combination with an open end inwardly flanged shell or [in casement, an axally [bored plug partly of wood and partly of solid carbon, of a carbon electrode secured upon a screw, a surrounding of broken carbon for said carbon electrode and a variable air space between said plug and the solid carbon electrode.

527,647. STORAGE BATTERY; C. J. Reed, Philadelphia, Pa. Application filed June 5th, 1894. A positive storage battery electrode of grooved form surrounded by a perforated envelope not readily attacked by the battery liquid, in combination with a negative electrode which surrounds or envelopes the positive electrode and the perforated envelope and holds all of the parts firmly together.

528,648. STORAGE BATTERY; Chas. J. Reed, Philadelphia, Pa. Application filed June 8th, 1894. In an accumulator a solution of a cadmium salt in combination with two electrodes, the positive electrode containing a compound of lead.

528,669. GALVANIC BATTERY; M. M. Hayden, New York, N. Y. Application filed Feb. 21, 1894. In a galvanic battery, a porous cup provided with internal screw threads at the top for containing a depolarizing agent, a screw threaded plug therefor, and a vent channel through said plug.

528,672. CIRCUIT CLOSER; H. J. Hovey, Oak Park, Ill. Application filed Dec. 26, 1893. A circuit closer having in combination the electric contacts or terminals, a series of independently depressible plungers arranged to be depressed by an object moving lengthwise of the series, a deflectable portion arranged under the lengthwise of said series and adapted to be impinged and deflected by said independently depressible plungers, and means at one end of said depressible portion for communicating the movement thereof to said contacts.

528,684 ELECTRIC ARC LAMP; C. E. Ongley, New York, N. Y. Application filed Feb. 17th, 1894. The combination with a search light or projector body, of an extension thereon, an arc lamp in said extension and having pivoted carbon carrying arms extending into said body in front of a reflector, and means for moving the arms to maintain the arc.

528,685. TROLLEY CATCHER; A. S. Osborn, Rochester, N. Y. Application filed May 9th, 1894. The combination with a trolley arm and its operating cord, of a spring-operated shaft, a winding head of forked form attached thereto, a fixed ratchet, a spring-operated detent sliding on the shaft and engaging with the ratchet, a cord-holder pivoted to the end of the shaft opposite the winding head whereby the cord can wind on the latter, and a connection between the cord-holder and detent whereby the latter is disengaged from the ratchet when the cord-holder is raised.

528,740. SECONDARY BATTERY; E. M. Poston, Springfield, O. Application filed Jan. 29, 1894. A secondary battery consisting essentially of a series of sections, each of said sections comprising an outer casing, porous division walls in said casing, metallic plates or walls to form positive and negative electrodes at the respective ends of said casing, an elecrolytic fluid between said porous walls, active material arranged between the respective porous walls and the electrodes, and means for connecting said sections together.

528,744. INSULATING COMPOUND; Oscar Stiles, Omaha, Neb. Application filed March 26th, 1894. As a new insulating compound, the combination of six parts of alcohol, three parts of shellac, three parts of asbestos and one part each of mica and alum, all combined as and for the purpose set forth.

528,767. TROLLEY LINE BREAKER; C. H. Dey and J. M. Anderson, Boston, Mass. Application filed Feb. 16, 1894. In a trolley line breaker or insulating joint, a double insulation consisting of two insulators provided with internally screw threaded bonnets or sleeves, a coupling piece provided with screw-threaded arms with which said internally screw-threaded bonnets or sleeves engage and a cushioning material interposed between the arms and insulator and between the insulator and its bonnet.

528,778. ELECTRICAL TRANSFORMER; R. M. Hunter, Philadelphia, Pa. Application filed April 6th, 1894. In an electrical converter the combinatio of the coils thereof insulated with a wrapper of porous fibrous material, and inclosing case hermetically sealing the coils, an atmosphere within the case and surrounding the insulated wires free from moisture, four or more terminals from the coils within the case extending to without the same, and the moisture proof seals sealing the outlets for the terminals.

528,788. BOND FOR ELECTRIC RAILWAYS; H. B. Nichols and F. H. Lincoln, Philadelphia, Pa. Application filed September 20, 1894. This comprises a rail provided with an opening, a bonding wire, nuts engaging therewith and provided with flanges engaging the openings of the rail, one of the nuts provided with a pour hole to permit of moulten metallic material being introduced into the same so as to expand and establish an air and water-tight connection of the rail with the bonding wire.

528,870. APPARATUS FOR MEASURING ELECTRICITY. W. Friese-Greene, London, England. Application filed March 28, 1894. In an apparatus for measuring electricity, the combination of a core or solenoid located in the main circuit, a fixed and movable rod adjacent to said solenoid, a curved arm on said movable rod provided with teeth at its outer end, a solenoid provided with a plunger, clock-work mechanism for operating said plunger, a bar provided with a stud adapted to slide on said curved arm, the stud meshing with the teeth, and the bar being operated by the plunger.

528,881. ELECTRIC LEAK-ALARM; Chas. C. Kahne, A. A. Adkins, W. S. Pierce, J. E. Martin and G. F. Kahne, Ashland, Ky. Application filed July 6, 1894. In an electric leak-alarm, the combination of a box, having a movable cover, a float working in said box, the contact plate attached to said cover above the float, and an upwardly projecting contact post carried by the float and adapted to be raised against the plate; said plate and contact post being connected with the respective terminals of an alarm circuit.

528,893. RHEOSTAT; Alton J. Shaw, Muskegon, Mich. Application filed April 10, 1894. A resistance device consisting of a band of ribbon of conducting material, crimped or folded facewise, and then coiled edgewise.

528,894. RHEOSTAT; Alton J. Shaw, Muskegon, Mich. Application filed April 10, 1894. A rheostat consisting of a series of blocks provided with 'ateral contact plates, a series of folded conducting strips interposed between the blocks and connected therewith in series, and a movable contact adapted and arranged to sweep the contact plates.

528,900. ELECTRIC SWITCH.; Frank G. Bolles, Washington, D. C. Application filed March 27th, 1894. In an electric switch, the combination with a clamping device for tightening the hinge joint of the movable contact, of a similar device for tightening the contact between the switch terminals, and means for operating them simultaneously.

528,902. MEANS FOR MULTIPLEX TELEGRAPHING BETWEEN CARS OF RAILWAYS; Aaron Fryer, Bath-on-Hudson, N. Y. The combination with a line wire which is supported parallel with a track of a railway and relatively at a side of the same, two cars distant from each other and on the same track, and having, each a trolley arm under control of an operator and pivoted to it, a horizontal spindle carried by the arm, a trolley wheel loosely mounted on the spindle for contact with the line wire, a tension spring between the trolley arm and car for holding the trolley wheel in contact with the line wire, while either or both cars are moving, a telegraphing or signaling apparatus and the wire for connection of the spindle with the apparatus, whereby signals may at will be had between cars

528,907. RHEOSTAT AND HEATER; Robert C. Mitchell, New York. Application filed Jan. 17th, 1894. The combination in a heater of a metal base, the resistance wire with the perforated sheet of non-fusible insulation interposed between the base and wire with a covering of insulating substance

*Owing to the Patent Office mail being held for fumigation, the patent specifications this week and last arrived too late to have the usual illustrations made.

The Electrical World.

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CONTENTS.

THE INCANDESCENT FILAMENT.

Some surprise has been expressed that the famous incandescent lamp litigation between the Westinghouse and General Electric interests is still pending, the impression being general that the decision of 1892 was final. The case recently argued before the United States Supreme Court, however, which is an appeal of the McKeesport case, does not involve the incandescent lamp as a whole, the issue being narrowed to the fibrous filament in an arched form. Should the Supreme Court reverse the decision of the lower court, the Sawyer-Man patent, dated May 12, 1885, will be revived as far as concerns the arched fibrous filament, and its life continued to 1902, unless abridged by a foreign patent. It is claimed, however, that this would have no important effect, as the art is not confined to the use of a fibrous material for the incandescent lamp filament.

ELECTRICITY AS A MOTIVE POWER.

It is sometimes said, and truly we believe, that the most conservative engineers in the world are those who have to do with the motive power of steam railways. As a rule they seem to view every engineering innovation with jealous suspicion, and at their professional meetings are apt to make it uncomfortable for the one who is rash enough to propose changing materially the existing order of things. It is, therefore, significant when men of this class speak strongly, even enthusiastically, in favor of electric traction, and this they do in the New York *Herald* of Sunday, which prints the views of the superintendents of motive power of the leading steam railways entering New York and vicinity as to the best motive power for the New York rapid transit roads. The ardent advocate of electricity could not favor more warmly the use of that agent for the purpose referred to. As steam is entirely out of the question, they were able to view the matter in an unbiased light, and we doubt if it occurred to them that their arguments would also apply to the use of electrical power, to some extent at least, on their own roads. One of those interviewed makes the general statement that electricity "is "just the perfect way of applying power," and adds, "Just think of "it, electricity does it all; absolutely all that is required. First of "all, you must have the power, and the electric motor on your engine, led over a wire from the dynamos, gives it to you; then you "must have light, both for your tunnel and your cars, and you want "a good light, too, and you get it by the same means; and then there "is the question of heating—and an important one—and that you can "get from the electricity. If ventilating fans are needed they can be "run by the same power. Could anything, under the present state "of knowledge, be more perfect? Motive power, light, air and heat "all from the same central power plant,"—which puts the case as strongly as any electrical engineer could wish. Another superintendent states that "the electric motor fills the bill exactly, and nothing "else approaches it;" and still another that "there is really no other "engine that I know of nearly so good as the electric motor operated "from a conducting wire." Not one of those interviewed repeated the remark, so familiar even a short time ago, about the experimental stage of the art, and from the references to the intramural road at the Chicago Fair it is evident that the object lesson it afforded has had a most valuable effect.

THEORY OF THE INCANDESCENT LAMP.

Prof. H. S. Weber's paper on the theory of the incandescent lamp, an abstract of which was printed in our last issue, is by far the most important contribution yet made to the subject. The best work heretofore done in this line has been by Americans, but it has been rather fragmentary, while the paper of Prof. Weber is exhaustive in its scope, and embodies the first attempt to treat the

subject from other than an empirical standpoint. As stated in the paper, the starting point of the work was the establishment of an expression by means of which the intensity of radiation of a given wave-length emitted by a filament at a given temperature might be expressed in terms of the wave-length and temperature, and of the size and nature of the radiating surface, the radiation being expressed in terms of the corresponding energy. By means of this equation the temperature of the filament can also be calculated, and we learn through this the surprising fact that the normal temperature of all kinds of incandescent filaments is very nearly the same, and included between an interval of 1292° and 1307° centigrade, and that the filament of a 16-cp lamp only changes 180° C. in temperature from two to thirty candle-power. The law of change of temperature for practical variations therefore becomes very simple, every increase of the energy of the current amounting to one-half per cent. raising the temperature of the filament 1° C. Prof. Weber found from his exhaustive experiments that the empirical relation, according to which the intensity of light is proportional to the cube of the energy transformed, well founded, and combining this relation with those he had himself established, it is shown that a rise of one degree in temperature within working limits produces a diminution of one per cent. of energy necessary for the production of a unit of light. A useful practical result of Prof. Weber's work is that we are now enabled to calculate very exactly the dimensions of a filament for a given purpose. By far the most interesting result, however, is the application of the general expression established to the calculation of the optical efficiency of the incandescent filament. We have recently referred to the uncertainty of the data on this point, and Prof. Weber finds that the experimental determinations of Blattner and Merritt are in error owing to unjustifiable assumptions; applying corrections to their results as far as concerns the absorption of dark rays, he reduces the value of the former from 5 per cent. to percentages varying from 3 to 4.9, depending upon the temperature of the filament. From his own expression, however, he calculates an optical efficiency varying from .55 to 1.17 per cent. according to the temperature of the filament, and concludes that for normal temperatures of incandescent filaments the optical efficiency is in the neighborhood of 1 per cent. While this does not agree with the surprising value of Ebert, which we have lately discussed, yet, as it is based upon theoretical grounds that have been checked throughout by experiment, it seems to merit more confidence than any other value yet offered.

SYMBOLS AND ABBREVIATIONS.

We print elsewhere an editorial of our esteemed London contemporary, the *Electrical Review*, which takes exception to our recent remarks on Prof. Jamieson's criticism of the symbols, notation and abbreviations which the Committee on Notation of the Chicago International Electrical Congress recommended "for international employment for practical use." In characterizing Prof. Jamieson as "an unfriendly critic with a rival system" we meant no personal disrespect, for none more thoroughly appreciates than ourselves his sterling qualities, both professional and personal. Certainly a criticism cannot be considered friendly that repudiates almost every essential point of the International Congress system and which, if it were to have the effect intended, would deprive us of almost the only possible hope of ever arriving at an international agreement on the subject. For if the attempt inaugurated at Chicago fails, a succeeding one will not stand any better chance of success, as the details must be largely matters of opinion which cannot be satisfactory to all, and the first failure will discredit further experiments. The important matter is uniformity in symbols, notation and abbreviations and to this the question of details is largely subsidiary. This matter has been a pressing one and the action at Chicago in recommending the system of M. Hospitalier gave it an advantage which would counterbalance many demerits in detail, did it possess them, which we do not think it does. Prof. Jamieson was at Chicago, we believe, and must have been aware that the system of Prof. Hospitalier was to be brought before the Chamber of Delegates. He should then have entered his objections, which he certainly could have done through one of the delegates. It is certainly a late day to do so now, particularly in view of the fact that in this country the system has entered into general use, and before another Congress could be held, will probably have become permanently fixed notwithstanding the most strenuous efforts that might be made to supercede it by one of less authority. If, therefore, the changes recommended by Prof. Jamieson were ever so desirable, we would, though with regret, still consider them entirely impracticable as tending to defeat an object which is higher than the mere perfection of details. While, as our contemporary states, Prof. Jamieson is entirely within his rights in criticizing the system in question, we doubt the expediency of his so doing at the present time, unless he prefers no system rather than the Congress one, and by destroying it, render still smaller the probability of future uniformity. As to the International Electrical Congress not having formally adopted the system, the reason is simply because it was not within its province to do so. Its formal action was confined to the adoption of measures for subsequent governmental action, and it could scarcely have called upon the various governments of the world to legalize a system of notation. The recognition it did give was, therefore, as complete as it had the power to give, and even more than might have reasonably been expected. The criticism by implication of the Committee of Notation we believe to be uncalled for; as it was composed of Ferraris, Ayrton, Carhart, Hospitalier, Palaz, A. Siemens and Dr. Budde, it appears to have been sufficiently expert and international. As to the fullest scope for discussion and the expression of diverse opinion, there was ample opportunity for this before the meeting of the Congress. The system had been before the world for some years; it had been formally brought in 1891 before the Frankfort Congress and was by it referred to a Committee for report to the next Congress, and it was published by the Committee on the Provisional Programme for the Chicago Congress in order to invite discussion. It is rather unreasonable, in the light of this, to imply that there was not ample opportunity to publicly criticize the measure. Finally, the system of Prof. Jamieson was embodied in a paper read before the Congress, and even if the members of the Committee on Notation—two of whom are compatriots of Prof. Jamieson—were not aware of its contents, the majority, we feel sure in saying, were acquainted with the system through Prof. Jamieson's "Pocket Book." As they entirely disregarded it, a fair presumption is that they did so for good reasons, and therefore one would be justified in considering Prof. Jamieson's attack on the system which did receive recognition as arising from the disappointment of a defeated rival.

Storage Battery Litigation.

A decision was rendered on November 5, in the United States Court of Appeals for the Second Circuit, in the case of the Accumulator Company vs. The Edison Electric Illuminating Company, and The Electric Storage Battery Company, by Judge Wallace, affirming the decision of Judge Lacombe, an abstract of which appears in The Electrical World of October 20, enjoining the Edison Electric Illuminating Company of New York from using the chloride battery, on the ground that it is an infringement of the Swan reissue patent.

The Chloride Storage Battery.

The Electric Storage Battery Company sends us the following communication in regard to the decision of the U. S. Court of Appeals for the Second District, in the case of Accumulator Company vs. Edison Electric Illuminating Company: "The day following the opinion of the Court upon the application of the counsel for the Edison Company, the Court gave leave to file an application for rehearing to be submitted in printed form, and accompanied with a printed argument in support thereof, and denied the motion of the counsel for the Accumulator Company for the mandate, holding that in abeyance until the decision was given upon the petition for a rehearing. The decision in no way affects the business of the Electric Storage Battery Company, but applies solely to the New York Edison contract, and even if affirmed will only delay that work until May next when the Swan patent expires."

Hermann von Helmholtz.

BY M. I. PUPIN.

It was in the autumn of 1885 when I began my studies under the late Prof. von Helmholtz. Kirchhoff was then still living. He lectured during that semester on the Mathematical Theory of Electricity. Helmholtz was director of the Physical Institute and lectured on Experimental Physics. As I think of those times now a comparison between the methods of these two great physicists suggests itself to my mind. This comparison seems to me to show Helmholtz in his true light as a teacher.

Kirchhoff's lectures were finished masterpieces of mathematical analysis and simple logic. There was nothing to add and nothing to subtract. No outside reading was necessary, in order to follow the rigid line of argument from beginning to end. But if one wished to supplement his lecture-room notes with outside reading, there was the literature of the German school of mathematical physicists, the school of Gauss, Neuman, Dirichlet, Riemann and others. Kirchhoff was a faithful apostle of this school. In spite of several interruptions due to Kirchhoff's illness to which he succumbed the same year, his course on electricity was completed by the end of the semester, so well was the work divided and so completely were the lectures under the control of the lecturer.

Helmholtz, on the other hand, rarely, if ever, seemed to have covered the whole ground of the subject which he proposed to discuss during the semester. But it should be remembered that the student measures the extent of that ground by the requirements for the doctor's degree examination. To supplement their lecture-room notes by outside reading was difficult to most beginners, for Helmholtz put things so differently from everybody else.

Kirchhoff's classes kept constant in number during the whole term. Those of Helmholtz, especially when he began to lecture on Mathematical Physics, grew smaller and smaller as the end of the semester approached. But then, Kirchhoff taught and Helmholtz inspired. Kirchhoff was an apostle, Helmholtz was a prophet. The masses wish to be instructed; it is only a small number, even in a German University as large as that of Berlin, who are open to inspiration. It was this small number who remained faithful to Helmholtz from the beginning of the semester to the end. In Kirchhoff's lectures it was the mathematical technique which seemed to play the most important part and to fascinate the student. Physical quantities were represented by functional symbols whose chief beauty seemed to consist in their fitting so well into certain mathematical operations. The young student was very apt to form an idea from these lectures that if it were not for mathematical analysis our knowledge of the physical phenomena would come to a standstill. More than half the number of those who attended Kirchhoff's lectures were pure mathematicians.

In Helmholtz's lectures it was the physical conception of the subject under discussion which stood out prominently and challenged the attention of his hearers. The mathematical treatment of it looked like a matter of convenience, not of absolute necessity, and many a hearer of Helmholtz grasped for the first time the full meaning of mathematical analysis when he saw it perform the office of interpreter of Helmholtz's physical reasoning. To such men it would, of course, appear that if it were not for the advance of our knowledge of physical phenomena the progress of pure mathematics would come to a standstill. Those who were fortunate enough to get a strong grasp of Helmholtz's physical conceptions, did not in the least mind that on many an occasion there was a hitch in the purely mathematical parts of his lectures, nor the fact that his course did not work out completely all the details of the subject under discussion which the regulations or the doctor's degree examination required. In this sense many of Helmholtz's courses of lectures on Mathematical and Experimental Physics might be considered as unfinished, but they should then be compared to the unfinished pieces of sculpture of Michel Angelo. We admire in them the grand conception of the great sculptor and in this admiration we do not notice that a large part is only a crude and shapeless rock. The connoisseur grasps the artist's meaning and his imagination supplies the unfinished parts of the artist's work. But not everybody who visits the Medicean Chapel in Florence is filled with admiration of Michel Angelo's genius.

Among the many students who used to assemble in Helmholtz's lecture-room at the beginning of every term, there were usually but few who could follow the master to those arduous heights which he bade them ascend and obtain the wide view of the subject on which he discoursed. Hence the opinion which one hears from time to time that Helmholtz was a poor lecturer. Those who understood him had an unbounded admiration for his lectures and a feeling of deep affection and gratitude for the man to whose inspiring words they owed so much of their intellectual growth. The affection of his pupils for him he reciprocated in a quiet and dignified way. His pupils will understand fully the depth of feeling which prompted the following sentence in Helmholtz's preface to Hertz's "Principles of Mechanics," lately published. Speaking of the sorrow which the scientific world felt over the death of Hertz, he says: "I myself have felt this sorrow deeply, for among all the pupils which I have had I always felt that I could consider Hertz as the one who had gained the deepest penetration into the sphere of my own scientific ideas, and I dared to cherish the strongest of hopes that he would develop and extend them."

HERMANN VON HELMHOLTZ.
(From the Painting by Knaus)

In many respects the method of Helmholtz's teaching was like that of Socrates. He devoted the greatest possible attention to the formation of correct scientific ideas in the minds of his pupils. A clear and complete exposition of the fundamental concepts and principles received his closest attention. He seemed to consider this as very much more important than the application of these principles to the solution of a great variety of physical problems. Just as in his writings, so in the lecture-room, he never hesitated to cross what some would consider the boundary line which separates Physics from Metaphysics, in order to show clearly the very roots of the elementary concepts which underlie the Science of Physics. I remember well his discourse on the meaning of *force*, a discourse with which he usually introduced his course of lectures on Experimental Physics. I saw it again afterwards in his public lecture on "The Aim and Progress of Physical Science," delivered in 1869. It is this: "To find the law by which they are regulated is to understand phenomena. For law is nothing more than the general conception in which a series of similarly recurring natural processes may be embraced. Just as we include in the conception 'mammal' all that is common to the man, the ape, the dog, the lion, the hare, the horse, the whale, etc., so we comprehend in the law of refraction that which we observe to recur regularly when a ray of light of any color passes in any direction through the common boundary of any too transparent media. A law of nature, however, is not a mere logical conception that we have adopted as a kind of memoria technica, to enable us to remember facts more readily. We of the present day have already sufficient insight to know that the laws of nature are not things which we can evolve by any speculative method. On the contrary, we have to discover them in facts; we have to test them by repeated observation or experiment, in constantly new cases, under ever-varying circumstances; in proportion only as they hold good under a constantly increasing number of cases and with greater delicacy in the means of observation, does our confidence in their trustworthiness rise.

"Thus the laws of nature occupy the position of a power with which we are not familiar, not to be arbitrarily selected and determined in our minds, as one might devise various systems of classifying animals and plants, so long as the subject is only one of classification. Before we can say that our knowledge of any one law of nature is complete we must see that it holds good without exception, and make this the test of its correctness. If we can be assured that the conditions under which the law operates have presented themselves, the result must ensue without arbitrariness, without choice, without our coöperation, and from the very necessity which regulates the things of the external world as well as our perception. *The law then takes the form of an objective power, and for that reason we call it force.* For instance, we regard the law of refraction objectively as a refractive force in transparent substances, the law of chemical affinity as the elective force exhibited by different bodies towards one another. In the same way, we speak of electrical force of contact of metals, of a force of adhesion, capillary force, and so on. Under these names are stated objectively laws which for the most part comprise small series of natural processes, the conditions of which are somewhat involved. . . .

"The force arising from the presence of such and such bodies is equivalent to the acceleration of the mass on which it operates multiplied by this mass. The actual meaning of such an equation is that it expresses the following law: If such and such masses are present and no other, such and such acceleration of their individual points occur. Its actual signification may be compared with the facts and tested by them. The abstract conception of force we thus introduce implies moreover, that we did not discover this law at random, that it is an essential law of phenomena. Our desire to comprehend natural phenomena, in other words, to ascertain their laws, thus takes another form of expression,—that is, we have to seek out the forces which are the causes of phenomena."

Who can still entertain any doubt as to the meaning of the physical concept *force* after hearing such a discourse? I confess that this discourse revolutionized my ideas on the subject of Mechanics, and of Physics in general. It seemed to lift a cloud from my mind, and I felt as if I saw light for the first time in my life. I have not met a pupil of Helmholtz yet who did not share my feelings. This was only one of the many discourses which could not fail to produce the most profound impression upon the minds of his more advanced pupils and to mark distinct epochs in the development of their scientific ideas.

In the laboratory he was the same as in the lecture room; he seldom allowed himself to enter into a discussion of the minor details of a man's work. He would always listen patiently to his pupil's account of the progress in his investigation; points of small importance left him indifferent; a mention of real a difficulty would always strike a sympathetic chord in his heart. His expression would then suddenly change, and you saw before you the magnificent face of Helmholtz, the philosopher, wrapped in serious attention as if searching carefully through the endless labyrinth of his mighty brain for a solution of your difficulty. Before he concluded his visit to your room the deep furrows on his Olympian brow would in all probability smoothen out gradually and then it would seem as if the shadow of his contracted eyebrows had lifted from his luminious eyes. Their benevolent light would then bring the cheerful news to you that Helmholtz, your friend, had found a solution of your difficulty and was ready to help you. You saw before you Helmholtz, the discoverer, rejoicing in a little discovery which is going to help you, but which gives the discoverer just as much pleasure as if it were going to add new glory to his already brilliant fame. In a few and simple words he would then give you his fatherly advice, bow politely, and proceed on his way to your next door neighbor where Gordian knots in form of experimental difficulties of perhaps entirely different nature waited for his intellectual sword. On such occasions you would stand as if spell bound for many a minute after his departure. His pleasing gentle voice would keep on ringing in your ear, the new view of your own subject of investigation which he had just suggested to you would gradually develop broader and sharper in definition, and the image of his magnificent face would seem to have produced an impression on your memory that would remain there forever with undiminished intensity. I often wished that I had the painter's skill so as to be able to fix on canvas the magnificent play of expression on his intellectual face whenever in the lecture-room or in the laboratory Helmholtz attacked and completely vanquished a difficult problem. It is beyond description. His photographs give no trace of it. There is one picture, only, which reminds one of it very vividly. It is the portrait of Helmholtz by Knaus in the National Gallery in Berlin. It represents Helmholtz as he used to look when he revolved in his mind a bright idea which suggested the solution of a difficult problem. The engraving accompanying this note is from a photograph of this portrait.

What he was to his pupils that indeed he also was to all the scientific world; a great intellectual leader, leading on steadily to greater and greater intellectual victories. So broad and so profound, so epoch-making and so penetrating were his intellectual powers that if real prophets in science ever existed he was certainly one of the greatest among them.

Professor von Helmholtz.

BY HENRY S. CARHART.

It needed no deep intuition at the opening of the Chicago Electrical Congress to discover the intense satisfaction with which the hundreds of persons interested in the science of electricity listened to the simple, kindly words of Professor von Helmholtz on assuming the honorary presidency. On the platform about him sat the official delegates of ten governments; in the audience were not only representative electricians from every part of the United States, but many from foreign lands. These all with a sudden impulse rose to their feet in hearty welcome and with spontaneous homage as this man of world-wide fame stepped forward to respond to the words of welcome addressed to him.

America saluted Germany, and American enthusiasm was reflected from the glowing faces of a small group of his countrymen and colleagues in attendance. It should be gratifying to the Americans who were there to know that the honor was appreciated. When Professor Rowland and myself, who were delegated to confer with him respecting his acceptance of the honorary presidency, called to see him, he received us with much cordiality, and showed unreservedly the fullest appreciation of the honor which it was desired he should receive.

At the dinner given in honor of the foreign official delegates every man felt himself personally included when this grand representative of sturdy German science addressed the company under the pleasing fiction of a father speaking to his children. No one present can forget the sympathetic tone of his remarks, and none could fail to note the indications that, under all American crudities, he still detected and recognized the worth that other less broad and penetrating minds might not discover.

Professor von Helmholtz could hardly have felt himself a stranger among us, for scores of Americans have been his pupils; and no one who has studied under him could fail to consider him a friend for, though never demonstrative, he was nevertheless always kindly and considerate. His daily round of the laboratory rooms was always an event to look forward to, for he was never in too much haste to be willing to give patient attention to any problems taxing the student's ability. The service which he thus rendered to students in his laboratory must be looked upon as a generous giving of himself, rather than as a necessity of the situation; for able assistants were in attendance to respond to all reasonable demands. At the time of my own experience there Dr. Hagen, now in the Reichsanstalt, was first assistant, and the brilliant, but now lamented, Professor Hertz was second assistant.

While his personal attention doubtless proved very stimulating to many American students of physics, yet it may fairly be questioned whether it was not rendered at too great a cost. When one considers the invaluable contributions to science which he made by investigations carried on in the remnants of time not absorbed by courses of lectures, and the exacting care of a large laboratory, one must regret that the investigator did not engross a larger portion of his time and the teacher less.

There was something almost pathetic in the account which he gave at the Edinburgh meeting of the British Association in 1892 of the difficulties encountered by an investigator, who must at the same time give attention to the affairs of a large physical laboratory. The picture which he drew was true to life, and was no less typical of America than of Germany. The question under discussion was the necessity of establishing national laboratories for physical and chemical research, like the Reichsanstalt in Berlin. Every man of similar experiences felt the truthfulness of his description of the manner in which one's time is consumed, and the injury done to the apparatus which one needs and which must also be used by students, till finally, when everything is in readiness for work, only perhaps a quarter of an hour remains for the "hauptsache." Under such unfavorable conditions as these Helmholtz carried through several series of researches which have let in the light on important physiological and physical problems for all time. His work was nearly finished before the liberality of Werner von Siemens and

the coöperation of the German government enabled him to devote his entire time to the direction of research.

Von Helmholtz has sometimes been called a poor lecturer, or at best an indifferent one. I cannot agree with that estimate of his work in the lecture room. He certainly was not a brilliant lecturer, and he sometimes made errors in his equations. But these errors were not those arising from lack of information or grasp of the principles involved. They were rather such slips as one commonly makes in manipulating mathematical symbols, when one has not taken the time to go over a lecture and to become familiar with its details. His methods were so original that the manner in which a conclusion was reached one year would very likely give place to another, when the same course of lectures came to be repeated. And it was often evident that he disregarded his notes before him and pursued a different plan. In so far as his lectures were faulty or contained errors in the details, the explanation probably lay in the fact that Helmholtz, the teacher, was sacrificing time to Helmholtz, the investigator.

I shall always carry with me a mental photograph of my last sight of this great man. It was on the Saturday afternoon following the closing of the Electrical Congress, and shortly after the delightful luncheon which he gave at the German Village in the Midway Plaisance to the members of the Chamber of Delegates and a few others. He was approaching the Administration Building from the west in a roller chair and unattended by friends. His large full eyes, alas! less brilliant than ten years earlier, were fixed aloft on that magnificent gilded dome which pierced the sky and formed the central point of attraction from every quarter. There was in his admiring gaze a touch of aspiration and reverence befitting one who was approaching so near to life's border land. The larger part of his work was on the border land of science in advance of most of his contemporaries. Almost the last thing which he said to me on leaving his laboratory was that the most promising field of physical research was on the dividing line between physics and chemistry. But he has crossed the greater border line, and his path, like the path of the just, "is as the shining light, that shineth more and more unto the perfect day."

The Bate Refrigerator Case.

The argument in the Bate Refrigerator case, which we are herewith enabled to present to our readers, so far as it has proceeded, through the kindness of C. L. Sturtevant, Esq., a prominent member of the patent bar of Washington, was begun before the United States Supreme Court the afternoon of Nov. 15, by Mr. Mitchell, and was continued the next day by that gentleman, Mr. Peckham, Mr. Wetmore and J. C Carter, who had not finished Friday afternoon, when the case was adjourned to Monday.

As our readers probably know, the question involved is as to the limitation of United States patents by a prior foreign patent. The contention in behalf of Bate is that Section 4887 of the Revised Statutes, causes a curtailment of the life of the American patent, when the foreign patent precedes the American *application*, while the defendant insists that it applies whenever the foreign grant precedes the American *issue*. The suit was originally brought by the Bate Company against Schwarzchild & Sulzberger, in the Southern District of New York, and the bill was dismissed upon defendant's plea that the patent had been issued in England upon the same invention, between the dates of the application for, and the issue of, the patent in the United States, and that, therefore, the latter patent had expired with the English patent, prior to bringing the suit. The case went to the Court of Appeals, and that Court certified the case to the Supreme Court of the United States, upon this question in effect: "When did, or when does, the patent granted Bate expire?"

Almost all the great companies, whose patents will be affected by this decision, were represented at the hearing, by counsel, among these being J. J. Storrow, for the Bell Company, and L. E. Curtis and Paul D. Cravath for the Electric Lighting Companies. W. H. Kenyon, it is understood, has filed a brief in support of the position taken by the defendants, on behalf of the Harrison International Telephone Company. B. F. Lee, for the Chemical Rubber Company, has filed a brief in support of the contention by the Bate Company, and ex-Solicitor-General Chas. H. Aldrich was given leave to file a brief for Milo G. Kellogg, of Chicago.

During the course of Mitchell's argument, Judge Brewer said, "I note that the oldest decision cited by you, as holding what you term the 'hostile view,' was rendered in 1882. That was twelve years ago. If the construction heretofore given by the courts was wrong, has there not been ample time to seek remedy by legislation by Congress?" To sum the matter up briefly, Mitchell and his associate contend that Section 8 of the act of 1836, and Section 6 of the act of 1839, having referred only to the *application* in this country, that R. S., 4887, being a substitute therefore, is by the marginal notes, or reference to this previous clause, to be construed in the light of the latter, and hence that the statute refers only to inventions patented abroad prior to the *filing of the application* here.

Mitchell finished his argument shortly after court convened Friday morning, and was followed by Wheeler H. Peckham, who preceded Edmund Wetmore. Peckham opened his argument by commenting on the recent patent to Berliner, arguing that he had allowed his case to stand in the Patent Office for many years, and had it issued just before expiration of Bell patent, and remarked that if the defendant's contention is sustained the monopoly of the Bell Company is prolonged nearly seventeen years, since Berliner had patented in many foreign countries *subsequence to his filing*, but *prior to the issue* here. He further remarked that the Berliner invention had been used on every telephone from the outset.

Wetmore, who followed Peckham for the defendant, summed up as follows: The Constitution of the United States provides for protecting inventions in order to promote useful arts in the United States. The country in which an invention is first patented is the one in which it will be first applied, because in such country it is protected and capital can therefore be interested. The country in which the invention is first applied is the one which will be first benefited. For this reason it is advantageous to enact such laws as will encourage the first patenting in this country; secondly, if a patent is obtained here for seventeen years, and previously in a foreign country, for say ten years, at the end of the ten years the foreign country's public will be the owners of the invention, and the article may be bought there for a small price, while the people of the United States will still be subject to the monopoly, and will, therefore, be placed at a disadvantage with reference to the foreigner. Judge Harlan here asked: "How about the case in which one obtains a patent here and then obtains one for a shorter foreign term?" Mr. Wetmore replied that the law had gone as far as it dared to correct the evil, for it said that a United States patent should be limited by the term of a foreign patent subsequently granted, it would practically destroy our patent system, and make a United States patent worthless, since the United States patentee could sell his patent granted here to-day, for $50,000,000, and could to-morrow obtain an Italian patent for one year, and thus make the United States patent all but worthless. He contended that the usual explanation of the construction of the section of the statute would be that the foreign patent must be granted prior to the grant of the United States patent; that such was the intention of the Congress which framed the act; that this had been ratified by all subsequent Congresses, for they had not changed the law, although the courts had uniformly given it its present construction. In response to a question from Judge Shiras, Mr. Wetmore admitted, of course, that he referred only to the Circuit Court decisions, and that they could have weight only as such before the Supreme Court. He said that the construction they asked for was the one which most strongly benefited the public of the United States, and was the only one which it is presumed was intended by the Congress which enacted the law. Finally, that while the Bate Company has a large capital at stake, it is nothing compared with the immense amount of capital which has been invested because of the present construction of the statute, and that this capital would be rendered almost worthless if the Supreme Court changed the construction of the law.

Mr. Carter followed Wetmore, but did not finish on Friday evening. He opened by saying that a patent is a contract, and that a consideration should be had of the law as it existed at the time the contract was made. That it had been repeatedly held that the United States must rigidly perform its side of the contract. That the contract is to the effect that if the inventor will describe fully his invention and file this with the proper officer, the United States will grant him a patent. That applicant accepts the contract, and the same is consummated as soon as the *application is filed*.

Introduction of Telegraphy.

According to the British Board of Trade statistics, the first telegraph line which was ever opened was in Germany in the year 1833; the next that in Great Britain in 1837, and then in the United States in 1844; Spain had no lines until 1885.

Odd but Consistent English Names.

A town in Scotland in which the electric light is about to be introduced has the curious name of "Motherswell" and there is said to be a small promontory near it called "Bubhe Babyshill."

The Society of Naval Architects and Marine Engineers.

At the successful meeting in New York last week of the Society of Naval Architects and Marine Engineers, two papers were presented dealing with electrical subjects, one by Lieut. S. Dana Greene, of the General Electrical Company on "Electricity on Shipboard" and the other by Naval Constructor W. J. Baxter, U. S. Navy, in which is incidentally described an electrical method of determining the co-efficient of friction of launching ways.

Lieut. Greene advises the naval architect in designing and installing a marine electric plant, whether it is for a man-of-war, merchantman, or yacht, to see that the material is ordered from manufacturers who have made a specialty of marine apparatus and to have it installed by practical marine electricians, who beside knowing something about electricity, know what a ship is and what the conditions are at sea. The plant should be put in charge of good practical, dynamo-tenders, by which is meant men who are familiar with both steam and electrical machinery and their fittings. The best practice in electric installations, it is added, is to be found in the various navies of the world, where specifications are always more rigid and work is better done (at greater expense of course) and more closely inspected. Referring to the naval specification requiring that the maximum rise of temperature shall be only 50° Fahr., he states that this low limit makes the dynamos expensive, and a limit of 60° or 70 Fahr, can be allowed with reasonable safety in the merchant marine under ordinary conditions. Lieut. Greene opposes the use of lead covered wire aboard ship and recommends the employment of iron tubing lined with a non-conducting material for circuits passing through the engine and fore-rooms, and bunkers and along exposed decks.

The employment of electric motors is advocated for ammunition hoists, handling the turrets of battle ships and the heavy turret guns, and for torpedo discharge apparatus; also for ventilating blowers, portable drills and pumps, deck hoists located some distance from the boilers, for driving ice machinery, opening and closing water-tight doors and operating machinery in engineers' workshop and the valves of the steam steering engine, and eventually displacing the steam steering engine itself.

All of the various electrical appliances now in use in the navy are explained at greater or less length, and in conclusion attention is directed to the possible use of steam turbines direct coupled to dynamos. It is stated that their great compactness and simplicity of construction make them particularly suitable for marine plants, while their comparative high speed permits of the use of a very cheap dynamo; for in dynamo construction the cost of manufacture varies almost inversely as the speed. Several shore plants using the direct connected steam turbine have been installed in England, and the reports thus far are very favorable. If they prove reliable in service, some sacrifice of steam efficiency can well be afforded with their introduction aboard ship, on account of their many compensating advantages.

Naval Constructor W. J. Baxter, U. S. Navy, in a paper entitled "Notes on Launching" described an electrical method of determining launching velocities and co-efficients of friction, which are of great value in determining the resistances of ships after launching and the power required to stop them after leaving the ways. The apparatus used was the same as that employed on the contract trial of the U. S. S. "Bancroft" to determine very accurately the speed of the vessel. The instrument is a modification of the Morse register, and when employed on speed trials, five pens, electrically controlled and having a piano contact action are in operation. When the corresponding circuit is completed, a pen makes a dash on a paper tape which is moved by a clock train with extreme uniformity. The central or time pen is connected with a chronometer and marks each second; the revolution pen on each side marks each revolution of the port and starboard shafts; while the outer or range pens mark simultaneously the instants of beginning and ending the measured mile run, permitting a datum line to be drawn across the tape from which are measured the fractional parts of time and revolution.

The register was adapted for the launch of the "Raleigh" by fitting a make-circuit attachment, connecting with a revolution pen, to the axle of a pulley, around which was coiled a steel piano wire with one end connected ashore; the range pen was connected to a portable button in the hands of an observer; while the time pen was connected to a break-circuit chronometer and relay. The register and two sets of drums and pulleys were placed underneath the launching platform at the bow. When the men began sawing the sole piece, the observer signalled to an assistant, who threw on the circuit and started the register; the time pen began marking at once, and, as the ship moved, the revolution pens began marking, all three acting automatically until the finish. The observer, with the range pens, noted the time of starting, letting go the anchor, pivoting, stoppers breaking, and hawsers tautened. etc. Owing to the admirable performance of the register, very accurate results were derived, both on the launch of the "Texas" and the "Raleigh" and many data of value deduced.

Symbols and Abbreviations.

We are quite at a loss to understand, says the London *Electrical Review*, why The Electrical World should, in an article with the above heading, published in its issue of October 13, characterize Professor Jamieson as "an unfriendly critic with a rival system." We are quite certain that his strictures on the recommendations of the Committee on Notation, which we published alongside these recommendations in our issue of September 21, were conceived in no unfriendly spirit, and that nothing unfriendly was meant by him, who has the furtherance of the object sought after as much at heart as any man we know. Regarding his having a "rival system," that surely is a very wrong and paltry way of looking at the matter. Our correspondent is a man who holds strong and decided opinions upon certain subjects, and naturally claims and exercises the right to express and to advocate his views, so long as it is open to him to do so. That he is still quite within his rights in criticising the proposed scheme is apparent from the following quotation from our American contemporary, which appeared in the issue of September 2, 1893: "The table of symbols and abbreviations recommended by the sub-committee of the delegates and received by the chamber of delegates, *without, however, being adopted by them*, is, with few changes, like the original proposition of M. Hospitalier, and published in the Electrical World of June 10, 1893." This shows that the whole thing is merely tentative; else, why was it not adopted by the Congress and recommended by them for adoption as an international table? It is just possible, however, that it is because our correspondent disagrees more with the personal recommendations of the Electrical World, and of M. Hospitalier, than with the international ones, that our contemporary unkindly describes him as "unfriendly." If the recommendations were really international in the proper sense of the term, there would be much more likelihood of their immediate adoption. In any such system there must be a great deal of give and take—the sinking of mere personal inclinations before the will or usages of the majority. But, in order to merit such give and take, the body which draws up such recommendations must fulfil three conditions: (1) It must be composed of experts; (2) it must be truly international; and (3), it ought to give the fullest scope for discussion and the expression of diverse opinions. With regard to the first condition, there was only one man, or at most two, in the whole committee who had really studied the subject. With regard to the second, was it really international? Is it not the case that this country was represented at the discussion by only one man, and he of foreign birth? And with regard to the third, were any steps whatever taken to throw the meetings open, or to obtain the views of those who were best entitled to express them? As our contemporary has very justly remarked, "Only delegates and a few invited guests were admitted to the sessions, which, in our opinion, was a most unfortunate feature, as the countries will probably never know how efficient or inefficient their delegates were." In fact, the whole thing seems to have been got up without due preparation and certainly without adequate realization of the importance of the issues involved.

Electrical Muscle Making.

In our issue of August 11th, we published a short filler under this heading, based on an abstract in the Digest of the preceding issue under the heading "Electricity in Therapeutics." As these brief abstracts have since been reprinted in other papers, and judging from the number of inquiries we have received, have been of special interest to a large number of readers, and as the matter from which this was taken was published in an English journal that may not be accessible to many, we reprint below the whole editorial on this subject which appeared under the heading "Electricity in Therapeutics" in the London Electrical Review of July 13th. Those specially interested will do well to read the original French article.

"Electricity has been used for many years in a rule of thumb fashion for stimulating the nutrition of the muscular system. It is quite time the matter were treated more scientifically. In the application of electricity to human diseases, there has always been too much of an appearance of quackery; and the "G. P." usually resorts to it only as a last resource, without having any views or

knowledge as to its precise action. Researches like those recently made by Debedat (*vide Arch.d'Electricité Médicale*, March, 1894) are calculated to change all this, and make electricity as certain a remedy as are the mercury compounds in cases of syphilis. The preliminary experiments were wisely made upon animals, rabbits being selected as the victims to science. The various kinds of electrical stimulation used in medical treatment were all tried, and the results of the investigation are now accessible. The groups of "ham-string" muscles were chiefly experimented with; those of the left side being stimulated daily for twenty days, four minutes per diem, and those of the right side being left for purposes of comparison. At the end of the period the animals were killed and the muscles of the two sides removed and weighed. Portions were also hardened and examined microscopically. The modes of stimulation were as follows:—(1) Induction-coil current; groups of shocks lasting each for one second and followed by one second interval of rest. (2) Galvanic battery current of 2 milliamperes with the same periods of stimulation and repose. (3) Static sparks of 2 to 3 milliamperes repeated every two seconds. (4) Tetanisation of muscles for four minutes by means of an induction coil without intervals of repose. (5) Steady galvanic battery current for four minutes without intervals of repose. The results showed a gain of 40 per cent. of weight on the stimulated side of the animal with (1) the rhythmic induction shocks, and of 18 per cent. with (2) the rhythmic battery current. The effect of (3), the static sparks, was *nil*. The prolonged tetanisation (4) caused a loss of weight. The prolonged steady battery current (5) caused a slight increase of weight. [Adhesions had been formed between the skin and the muscles at the points of application of the electrodes in this last series of experiments.] It is clear from the results of these experiments that the gain in weight of the muscles was due to a true growth of muscle; and that the loss of weight noticeable in certain of the experiments was accompanied by histological evidence of damage to the muscular fibres. Hence Debedat concludes that the most advantageous mode of promoting the healthy growth of muscle by means of electricity is to use an induction coil, and to arrange the periods of contraction and repose so as to approximate to the conditions of a muscle during the performance of rhythmic gymnastic movements, namely, about 30 periods of contraction and 30 periods of rest per minute. Proonged tetanisation is distinctly hurtful, and this shows that the methods most commonly made use of by ill-informed practitioners and worse informed quacks are entirely wrong."

Electrical Power Transmission—III.

BY LOUIS BELL, Ph D.

Concerning Electrical Energy.

16. Now return to Fig. 5 and consider the effect if the wireA is carrying a steady flow of electrical energy. It will set up electro-magnetic stresses about it as already described. If the current be downward into the paper in A these stresses will be opposed to the stresses in the field. Inasmuch as we have seen that in setting up such a current work had to be done in forcing the wire into the field it follows that given such a current, there must be between its field and that of the coil a repulsive force which had to be overcome by doing the work aforesaid. In other words, there must have been a tendency

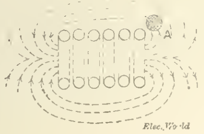
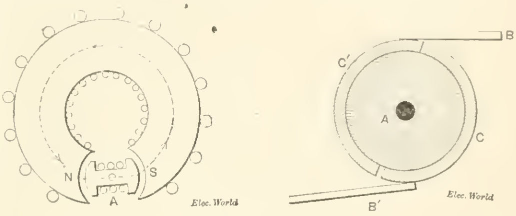


FIG. 5.

to throw A out of the field of the coil. Just as work had to be spent to produce electrical energy in A, so electrical energy will be spent in keeping up the stresses aroundA that tend to drive it out of the magnetic field. If the current in A were in the other direction the stresses in its field and that of the coil would be concurrent instead of opposed, and their resultant would tend to draw wire and coil together, *i. e.*, work would have to be spent to keep them apart. This is the broad principle of the electric motor. It is sometimes referred to as simply a reversal of the dynamo, but it really makes no difference whether the structure in which the action just described takes place is well fitted to generate current or not. Given a magnetic field and a wire carrying electrical energy, and there will be a force between them depending in direction on the directions of the electromagnetic stresses belonging to the two. If either element is arranged so as to move and still keep up a similar relation of these stresses we have an electric motor. Whether so arranged as to fulfil this condition with alternating currents, or in such manner as to require currents in one direction only, the principle is the same.

17. So far as unidirectional or "continuous" currents are concerned they are usually obtained from dynamo electric machines similar in principle to Fig. 8. This machine, if the ends of the winding on



FIGS. 8 AND 9.

the armature be connected to two metal rings insulated from each other, serves as a source of alternating currents which can be taken off the two rings by brushes pressed against them. If it is necessary to obtain currents in one direction only, this can be readily done by reversing the connection of the outside circuit to the windings at the same moment that the current reverses in them. The simplest way of doing this is by a "two part commutator," such as is shown in diagram in Fig. 9. Here A is the shaft surrounded by an insulating bushing. On this are fitted two half rings C and C′, of metal (the commutator segments). On these bear brushes B and B′. If the ends of the winding are connected to C and C′ and the brushes are so placed that they pass from one segment to the other at the moment when the current in the winding changes its direction, the direction of the curient with respect to the brushes and the outside circuit with which they are connected will obviously remain constant.

18. In the actual practice of dynamo building very many refinements have to be introduced to serve various purposes, but the underlying principle remains the same, *i. e.*, to set up in a conductor electromotive stresses by dragging it into and out of the strained region of ether under an electromagnetic stress.

As the dynamo is intended for producing continuous or alternating currents its structure is somewhat modified with its particular use in view. These modifications extend not only to the general arrangement but to the details of the winding. Alternating dynamos usually have a more complicated magnetic structure than continuous current machines, and are almost invariably separately excited, *i. e.*, have their magnetizing current supplied from a generator specialized for producing continuous current. The magnetic complication is really only apparent as it consists merely of an increased number of magnet poles, due to the desirability of obtaining tolerably rapid alternations of current.

Dynamos designed for producing continuous current are modified with the armature as a starting point. The winding is very generally much more complicated than that of an alternator and the commutator that serves to reverse the relation of the windings to the brushes at the proper moment is correspondingly elaborate. The magnetic structure is usually comparatively simple. The whole design is necessarily subordinated to securing proper commutation. Continuous current dynamos are almost universally self-excited, that is the current which magnetizes the field is derived from the brushes of the machine itself. Whatever the character of the machine the electro-motive force generated in it increases with the intensity of the magnetic field (that is, the magnitude of the ether strains, which affect the armature conductors) with the speed (that is, the rate at which energy is expended in driving the conductors through the field) and with the number of turns of wire of which the electromotive forces are added. The capacity of the machine for furnishing electrical energy varies directly with the electromotive force and with the capacity of the armature conductors for transmitting the energy without becoming overheated. Practically all the energy lost in a dynamo appears in the form of heat, which must be limited to an amount which will not cause an undue rise of temperature.

It is not the purpose of this chapter to deal with the practical

details of dynamo design and construction. For these, the reader should consult special treatises on the subject, which consider it with a fulness which would here be quite out of place. Special machines, however, will be briefly discussed in their proper places and in relation to the work they have to do.

19. Having now considered the principles which underlie the transformation of mechanical into electrical energy we may profitably take up the fundamental facts in regard to the measurement of that form of energy and the units in which it and its most important factors are reckoned.

All electrical quantities are measured directly or indirectly in terms of the dynamical units founded upon the units of length, mass, and time. These derived dynamical units can serve alike for the measurement of all forms of energy so that all have a common ground on which to stand. As the electrical units are derived directly from the same units that serve to measure ordinary mechanical effects, electrical and mechanical energies are mutually related in a perfectly definite way.

20. A natural starting point in the derivation of a working system of electrical units may be found in electromagnetic stress, such as is developed about an electrical circuit or a steel magnet. To begin with, the mechanical units that may serve to measure any form of force are derived from those of length, mass and time. These latter are almost universally taken as the centimetre, gramme and second. C. G. S. system. Starting from these the unit of force is that which acting for one second on a mass of one gramme can change its velocity by one centimetre per second. This unit is called the *dyne* and as a stress it is equivalent to about one $\frac{1}{1000}$ of a pound's weight on a unit pole one centimetre distant. This unit is inconveniently small for practical use and before long some multiple of it is likely to be given a special name and used for practical reference. Magnetic measurements may thus be made by direct reference to the dyne and centimetre.

21. Referring now to what has been said about the causes which vary the electromotive force produced in a dynamo, we fall at once into the definition of the unit electromotive force, which is that produced when field, velocity, and length of wire under induction are all of unit value. The unit electromotive force is, then, that which is generated in one centimetre of wire moving one centimetre per second, perpendicular to its own length, straight across unit field. This, too, is inconveniently small, so that one hundred million times this quantity is taken for the practical unit of electromotive force and called the *volt*.

The unit electrical current is that which flowing through one centimetre length of wire will create unit field at any point equidistant from all parts of the wire (as when the wire is bent to a curve of 1 cm. radius). One-tenth of this current is taken as the working unit and called the *ampère*.

The unit electrical resistance (one *ohm*) is that through which an electromotive force of one *volt* will send one *ampère*.

The C. G. S. unit of work or energy is unit force acting through unit distance, that is one *dyne* acting through one centimetre. As this is too small to be generally convenient, ten million times this amount is taken as the working unit (called the *joule*). This is a little less than three-quarters of a foot-pound (exactly .7373). The unit *rate* of doing work is one *joule* per second. This unit rate is called the *watt* and translating this into English measure, one *watt* equals $\frac{1}{746}$ *horse power*.

22. Although the watt is often spoken of as an electrical unit, it belongs no more to electrical than to any other form of energy. It only remains to show the relation of the *watt* to the more strictly electrical units just mentioned. Recurring to our definition of the volt, let us suppose that the resistance of the circuit of which the moving wire is a part is such that unit electromotive force produces unit current in it. The stress between the field of the moving wire and the other unit field through which it moves is one dyne. In maintaining this for one second at the given rate of moving (1 cm. per second) the work done is, as above, one C. G. S. unit. At this rate if the E. M. F. were 1 *volt* and the current 1 ampere, the work would be one *joule* and the rate of doing work one watt. If either E. M. F. or current were changed, the work would be proportionally changed. So, the number of volts multiplied by the number of amperes is numerically equal to the *watts, i. e.*, we have obtained the dynamical equivalent of the two factors that make up electrical energy as ordinarily reckoned. So the output of any dynamo in watts is determined by the volt-amperes produced, and we see the reason of the ordinary statement that 746 *volt amperes* make one horse power. This is always true whether the output is steady or variable, so long as we measure the product (volts and amperes) correctly.

What few other electrical units appear in practical work will be referred to in their proper places.

It has been the purpose of this chapter, not so much to set forth the ordinary elements of electrical study, as to present these elements as viewed from the standpoint of energy. The author has purposely avoided the conception of electricity as a material something, in favor of the idea of stresses in the medium producing strains which are propagated through the medium, thus effecting the transmission of electrical energy. Hereafter we shall have to do with the extension of this transmission to practical magnitudes, and its utilization in the development of human industry.

(To be continued).

Electrodynamic Machinery—XVII.

BY E. J. HOUSTON AND A. E. KENNELLY.

86. The type of curve represented in Figs. 64, 65 and 66, showing the E. M. F. generated by the rotation of a conducting loop in a uniform magnetic flux, may be produced by the rotation of the coil represented in Fig. 67. In practice, however, continuous current generators do not produce this type of E. M. F. Fig. 68 represents, in cross section, a common type of generator armature, situated between two field poles, N and S. The flux from these poles passes readily into and out of the armature surface as indicated by the arrows. In other words, the flux cuts the surface of the armature at right angles, while, in the cases shown in Figs. 57 to 60, the conducting loop is only cut by the flux at right angles in two positions 180° apart, so that the curve of E. M. F. is peaked at these points, and descends rapidly from them on each side.

87. Suppose in Fig. 68 that the difference of magnetic potential,

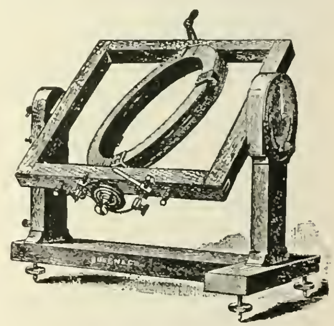


Fig. 67.—Coil for Inducing Feeble E. M. F.'s by Revolution in Earth's Magnetic Flux.

maintained between N and S, is 2,000 gilberts, that the diameter of the armature core S O *h*, is 40 cms., that its length is 100 cms , and that the air-gap or *entrefer* is 1 cm., then, if the reluctance of the iron armature core be regarded as negligibly small, the magnetic potential between the polar surfaces and the armature surface on each side, that is between *c* N *e* and A *g* B, also between *d* S *f* and A *h* B, will be 1,000 gilberts. The magnetic intensity in the air may be obtained in two ways.

(1) By considering the total reluctance of the air and obtaining the total flux through it. Thus the polar surface represented is 55 cms. in arc × 100 cms. in breadth = 5,500 sq. cms. The reluctance of the air-gap on either side of the armature is, therefore, $\frac{1}{5,500}$ oersted, and the total flux passing through the air will, therefore, be $\frac{1,000}{\frac{1}{5,500}}$ = 5,500,000 webers. This flux, divided by the area through which it passes, gives the intensity or, $\frac{5,500,000}{5,500}$ = 1,000 gausses.

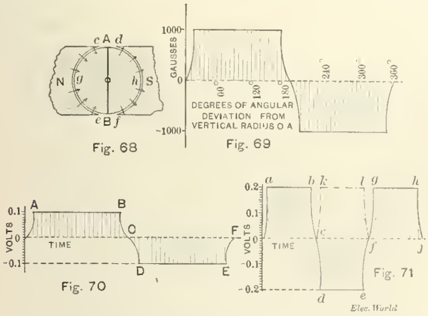
(2). The magnetic intensity is, as we have seen (Sec. 46), the drop of magnetic potential in air, or other non-magnetic material per centimetre, so that the drop of potential being here 1,000 gilberts in 1 cm. of distance in air, the intensity must be 1,000 gausses. Representing the intensity graphically, as shown in Fig. 69, it will be seen that the intensity is uniform from *c* to *e*, and then descends rapidly to zero at B, where it changes sign and becomes negatively directed, and is then uniform from *f* to *d*, falling again to zero at A. The flux direction, therefore, changes sign twice in each revolution.

88. If a wire AB be wound as a loop around the armature, it will, when the armature revolves, cut this flux at right angles, and

will, therefore, have induced in it an E. M. F., which must be of the same type graphically as the curve in Fig. 69. Thus, if the surface of the armature moves at a rate of 50 cms. per second, the E. M. F. induced in the loop will be $2\ v\ l\ \mathfrak{B}$, the factor 2 being required, since both sides of the loop are cutting flux, one at A, and the other at B, or

$$2 \times 50 \times 100 \times 1{,}000 = 10{,}000{,}000 \text{ C. G. S. units} = 0.1 \text{ volt.}$$

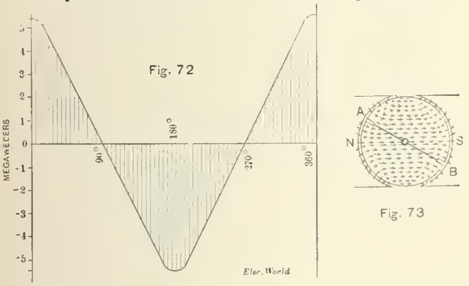
except at the moment when the wires emerge from beneath the pole pieces. This curve is represented in Fig. 70, where the distance OF represents the time of one complete revolution of the armature, and the elevation of A corresponds to 0.1 volt. If the armature be set revolving at twice this speed, the time occupied in a revolution will be halved, but the E. M. F. being proportional to the rate of cutting flux, will be doubled, as represented in Fig. 71, where the E. M.



Figs. 68, 69, 70 and 71.

F. is alternately 0.2 volts in each direction. By the aid of a suitably adjusted commutator, the E. M. F. instead of changing sign can be kept unidirectional in an external circuit following the curve *o a b c k l f g h i*.

89. We may regard the E. M. F. of the loop as being induced either by the cutting of the flux by the wire at the armature surface, or by the enclosure of the flux by the loop. The flux enclosed by the loop is represented by Fig. 72, where at the initial position at AB, the loop encloses 5,500,000 webers. As the armature is rotated counter-clockwise, so that A is carried towards N, the flux enclosed by the loop diminishes, until, when it reaches the horizontal position, the flux through the loop is zero. As the rotation continues, the flux re-enters the loop in the opposite direction, and becomes 5.5 megawebers at a position 180° distant from the initial position AB. The



Figs. 72 and 73.

rate of change of flux enclosed, or the gradient of the curve, shown in Fig. 72, is uniform, since the curve is uniformly steep, except near the position of maximum flux, where the gradient is considerably reduced, and the E. M. F. correspondingly reduced as already observed in Figs. 70 and 71.

90. When, however, the wire, instead of being on the surface of the armature is buried in a groove in the iron, as in a toothed-core armature (Sec. 17), and as shown in Fig. 72, then, since the wire cuts no flux, there being little or no flux at the base of the groove where the wire lies, it is necessary to suppose that the E. M. F. still induced in the wire by the rotation of the armature, is due to the rate of enclosing flux, and not to the rate of cutting flux, so that Fleming's hand rule cannot readily be applied. The following rule, will, therefore, be of assistance in determining the direction of the E. M. F. induced in a loop. If we consider that a watch dial is visible to the observer who holds it facing him, by the light which proceeds in straight lines from the watch to his eye, then the direction of the E. M. F. induced in a loop regarded as the outline of the watch face can be remembered by the following rule.

The induced E. M. F. has the same direction as the motion of the hands of the watch, when the flux entering the loop has the same direction as the light.

Flux entering the loop in the *opposite* direction will induce an E. M. F. in the *opposite* direction to the hands of the watch, that is, counter-clockwise.

A loop being emptied of flux will have an E. M. F. developed in it in the opposite direction to that which would be produced if the flux were entering.

(To be continued).

Notes on the Management of Railway Power Stations—VII.

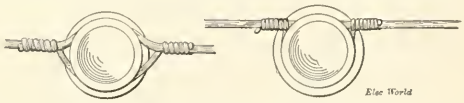
BY GEORGE T. HANCHETT.

The Line.

The construction of the distributing system of a railway power station, while usually planned and superintended by an engineer, depends for its maintenance and small additions upon the station manager and his corps of wiremen.

The average railway feeder is a heavily insulated stranded cable. It usually costs all the way from ten to fifty cents per foot, according to insulation, finish and size. When a management has gone to the expense of supplying heavy cables for reducing the loss on their feeders, there should be no joint admitted that is not mechanically and electrically equivalent to the body of the wire. A good joint on a railway feeder is a matter of several hours' labor. It will not pay to put poor work or expensive material. Start the joint by stripping the wire at least a foot from each end. In doing this whittle the insulation off and scrape clean. Do not cut around the wire with knife or plyers.

Hold the wire with the end pointing downward and with a brush thoroughly wet each wire with acid. Do not hold the wire in any other position till all the acid has been removed. If this caution is



Figs. 18 and 19.—Methods of Tying.

neglected, the acid will creep up the wire under the insulation and if any amount gets in among the strands it will corrode them and is liable to cut them off thereby.

Each wire should now be thoroughly tinned. This is best done by immersing each wire in a pot of melted solder and wiping off with a cloth damp with soldering acid. Do not rely on the tinning that may be on the wire. It is a help, but it is by no means sufficient. The tinning must be a thin, even coating of solder. It is not properly done if any lumps or thick layers are formed. If it is well done the joints will solder without acid.

Now make a twist joint between every strand with not less than four turns on each side. These joints should set along the main joint in line and not all in a bunch, thus making an unsightly lump of the finished joint.

Each joint should be thoroughly soldered. If a flame is used the wire should be hot enough to melt the solder with the flame removed before the solder is applied. Then and not till then apply with flame and solder. Thoroughly clean off all acid with a wet sponge and dry with a flame.

Paint the joint with P. & B., and when that is dry lay on a layer of tape, starting at the insulation, but not overlapping. Give the joint a second coat and start the next layer two or three inches back of the first one, overlapping the insulation. Paint this and put on a third layer, finishing with two coats of paint. Draw the tape tightly around the joint. If well done the joint should measure up less resistance than an equal length of continuous cable.

In tying never bend a kink in the line as in Fig. 18. The wire should be as in Fig. 19, and can be tightly held in that position. Insulators, such as are shown in Fig. 20, are much preferable to those shown in Fig. 21 for straight line work.

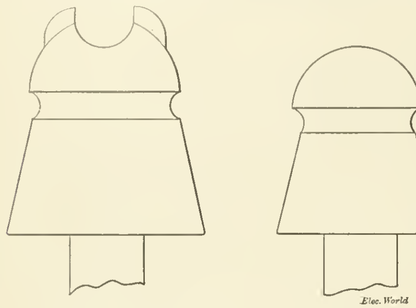
The insulator in Fig. 20 is in a position to support the wire. Fig. 21 is an idea which was very efficient with light wires and easy to construct and install, and as it is always hard for designers of construction material to break away from old ideas it is largely used for heavy feeders in cases where it is entirely unsuited. The strain of weight alone on a 0000 A. W. G. feeder on its insulator, is, roughly, one pound for every foot of span between poles.

The proper place for a beam is on top of its supporting column and not tied to the side with a wire, and heavy construction work should be laid out on the same principles.

Clamp insulators which avoid tie wires are very desirable. A heavy, well-designed insulator, comprised of two parts exactly alike and gripping with a suitable bolt, would be a great advantage. It would pay for its cost by the ease of its installation, the complete support it gives the wire and the freedom from abrasion. There are no heavy insulators of this type made.

Never screw an insulator on to an iron pin without first interposing cloth or paper. Insulators placed in winter without this precaution are sure to be strewn in pieces in the street on the ensuing summer, due to this fact that, iron expands almost twice as rapidly as glass.

In choosing insulators remember that symmetry is desirable, but that security and safety are the prime considerations. Where the



FIGS. 20 AND 21.—LINE INSULATORS.

pole line is of necessity crooked every pole may need a differently designed insulator from those on the poles adjacent.

The setting of a pole two or three feet out of line often results in a transverse strain of a hundred pounds or more on each insulator. If care and judgment as to the nature of the strain in each case is used, and the type insulator chosen to fit, the result may be unsymmetrical, but it is there to stay, which, after all, is the most important part.

The clamp insulator is here of great value, due to its all round utility in these cases. In line construction do not draw the wires any tighter than necessary to do the work properly and appear well. Many a trolley wire has dropped in the street for no other reason than that an excessive strain on the supporting wires by ratchet fasteners.

Guard wires depart from this rule from the fact that they do not carry the load when installed that they are destined to bear in service. They should therefore be much more tightly drawn than the rest of the construction. The guard wires should be completely insulated at their points of support or one-half of their value is gone.

Efficient lightning arresters on the poles save generators and motors. In a well constructed line, the lightning discharge should seldom reach either motor or station.

At the earliest convenience number each and every pole. Prepare a tracing of the whole line and hang blue prints of it in places where they can readily be inspected by linemen. Small prints with every run of poles marked with the highest and lowest numbers they contain should be issued to the foreman of every gang. The actual numbers of the poles should be painted upon them. By this means the inspector can locate exactly the needed repairs, describe them accurately to the lineman and keep a strict and intelligent account of the whole. Each lightning arrester and cut-out switch should be located on the large drawing. This system of numbering will not only facilitate line but track repairs as well. The use of letters will prevent the number from becoming inconveniently large. The track construction is a matter to which thought and design has been given, and only by severe and expensive lessons has the girder rail been evolved. It is very noticeable that after a great deal of capital has been spent in expensive material it is often ignorantly installed. The weak points of a track are its joints, frogs, plates and crossings, yet in constructing the line the average foreman seldom exercises any care as regards choosing ties to put under joints and sometimes he neglects to put one under at all.

A difficulty should be met on every side and while it is well to strive in the design of a truck to avoid the hammer blow, it is also wise to see that the joint is well supported by an exceptionally heavy tie and the earth especially well tamped around it.

The ground return next comes in for comment. There are two very popular subjects connected with it. First, the path of the current through the earth, and second, the energy lost in the return.

With regard to the first subject the writer believes that a little research and experiment would result in great savings.

If an electromotive force is applied to a homogeneous mass of metal the current will not fill it uniformly and flow from point to point.

Connect to the corners of a square tin plate the terminals of a storage cell and pass twenty or more amperes through it. With the terminals of a delicate galvanometer determine points of the same potential. The equipotential points will be found to differ very considerably from what geometrical conditions would suggest.

How much more then will a ground circuit, through a mass anything but homogeneous in its nature, deflect the current from its theoretical directions.

Heavy copper is often laid along street railroad tracks made to protect pipes at a distance of twenty or more feet from the damaging effects of electrolysis. In order to protect a pipe the copper should be laid near the pipe rather than the track.

The writer believes that a great many cases where heavy copper ground returns have failed to check electrolysis, have failed not because insufficient cross sections of return has been provided, but because it had an excessive resistance due to its length.

In Fig. 22 is shown a pipe system and a railway ground return. The current flows into the pipe system in large quantity, not because its resistance is less per thousand feet, but because the total resistance of the pipe is less, due to the short length across A B. The current takes this short cut to the station and the pipe would be protected by a copper wire of very moderate cross section run across A B, because the pipe line has an increased resistance due to poor electrical joints and the earth gaps at each end. If the ground

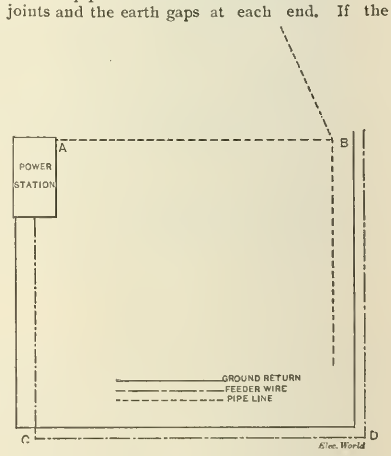


FIG. 22.—GROUND RETURN AND PIPE SYSTEM.

returns were planned as carefully as the overhead system, proportionately better results would be obtained. The following principle should be carefully borne in mind. *The ground return wires, if any are used, do not always give the best results laid in line with the track.* Lay them out in accordance with Ohm's law as if the earth were an insulator and the best results will be obtained.

It is not possible to protect a pipe system by simply remodeling the electric circuits at the points where the damage is done. A study of the whole system, both pipe and electric, must be made before an intelligent remedy can be applied.

The electrical energy at the station is readily measured, but the drop between the different points of the system from bus-bar to bus-bar is none the less important to determine. Measurement will disclose a drop in the trolley and car wheel contacts as well as in the feeder system and ground returns. In any event in planning a feeder system, feed from the middle and utilize the loop circuit wherever possible. Remember that while the resistance varies inversely as the cross section that that is the expensive way of reducing it. Resistance also varies directly as the length and by thus reducing it you realize a double gain. You reduce the resistance and use less copper rather than reduce and use more copper. There-

fore, be quick to utilize all short cuts to the station, and remember that while property owners might object to a heavy pole line in front of their houses they would be unreasonable indeed should they object to a buried ground return. Lastly bear in mind that it is by no means necessary and often disadvantageous to follow the car track with your copper both above and below the ground.

(To be continued.)

Practical Notes on Dynamo Calculation.—XVIII.

BY ALFRED E. WIENER.

In equation (98) the length, L_e, of effective armature conductor depends upon the polar embrace, which, in turn, is determined by the ratio of the distance between pole corners to the length of the air spaces; and can be expressed in terms of the total active length of wire, by

$$L_e = L_a \times \beta \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (99)$$

Inserting (99) into (98) we obtain the actual field density:

$$\mathcal{H} = \frac{b \times E \times 10^8}{72 \times \beta \times L_a \times S} \ldots\ldots\ldots\ldots\ldots\ldots (100)$$

where $\mathcal{H}$ = Actual field-density of dynamo, in lines of force per square inch;

b = Number of bifurcations of current in armature;

E = Total E. M. F. to be generated in armature, in volts;

β = Percentage of polar arc; see chapter 34.

L_a = Length of active armature conductor, in feet, formula (3), or (101);

S = Conductor-speed, in feet per second, formula (5).

Since, in a newly designed armature, on account of rounding off the number of conductors to a readily divisible number, and the length of the armature to a round dimension, the actual length, L_a of the armature conductor, in general, is somewhat different from that found by formula (3), (as a rule, a little greater a value is taken) it is preferable to deduce the accurate value of L_a from the data of the finished armature:

$$L_a = K \times \frac{la}{12} = \frac{o \times u}{p} \times \frac{la}{12}, \ldots\ldots\ldots\ldots (101)$$

where K = Total number of conductors on armature;

l_a = Length of armature core, in inches;

o = Number of wires per layer;

u = " " layers of armature wire; } see chapter 9.

p = " " wires stranded in parallel.

Formula (100) for the actual field density of toothed and perforated armatures, can also be used for smooth cores, and may be applied to check the result obtained from (96).

For the application to smooth armatures, however, the polar embrace β, in formula (100), is to be replaced by the corresponding value of the effective field circumference, β', obtained from the former by means of Table XXXII, chapter 20.

If it is desired to know the real field area in toothed and perforated armatures, an expression for A_f can be obtained by combining formulae (93) and (100), thus:

$$A_f = \frac{\Phi}{\mathcal{H}} = \frac{72 \times \beta \times L_a \times S \times \Phi}{b \times E \times 10^8} \ldots\ldots\ldots\ldots (102)$$

This formula, which gives the mean effective area actually traversed by the useful lines cutting the armature-conductors, is very useful for the investigation of the magnetic field of toothed and perforated armatures.

34.—Percentage of Polar Arc.

The ratio of polar embrace, to which frequent reference has been had, in Section 33, is determined as follows:

(*a*) *Distance Between Pole-corners.*

The mean distance between the pole-corners, e_p, Fig. 47, is decided upon according to the rule alluded to in chapter 33, viz., the rule of making that distance from 1.25 to 8 times the length of the two gap-spaces, according to the kind and size of the armature and to the number of poles, see Table XLVII.

Denoting this ratio of the distance between the pole-corners to the length of the gaps by k_{11}, this rule can be expressed by the formula:

$$e_p = k_{11} \times (d_p - d_a), \ldots\ldots\ldots\ldots\ldots (103)$$

where d_p = diameter of polepieces, in inches;

d_a = diameter of armature-core in inches; for toothed and perforated armatures, d_a is the diameter at the bottom of the slots.

The value of k_{11} for various cases may be chosen within the following limits:

TABLE XLVII.—RATIO OF DISTANCE BETWEEN POLE-CORNERS TO LENGTH OF GAP-SPACES, FOR VARIOUS KINDS AND SIZES OF ARMATURES.

Capacity, in Kilowatts.	Value of Ratio k_{11}					
	Smooth Armature.				Toothed or Perforated Armature.	
	Bipolar.		Multipolar.			
	Drum.	Ring.	Drum.	Ring.	Bipolar.	Multipolar
.1	1.5	2.5	1.5	2.5	1.25	1.25
.25	1.75	3	1.75	2.75	1.5	1.3
.5	2	3.5	2	3	1.75	1.4
1	2.25	4	2.25	3.25	2	1.5
2.5	2.5	4.5	2.75	3.5	2.25	1.6
5	3	5	3	3.75	2.5	1.7
10	3.5	5.5	3.25	4	2.75	1.8
25	4	6	3.5	4.25	3	1.9
50	4.5	6.5	3.75	4.5	3.25	2
100	5	7	4	4.75	3.5	2.1
200	5.5	7.5	4.25	5	3.75	2.2
300	6	8	4.5	5.25	4	2.3
400	....	....	4.75	5.5	....	2.4
600	....	....	5	5.75	....	2.5
800	....	....	....	6	....	2.6
1,000	....	....	....	6.5	....	2.7
1,200	....	....	....	7	....	2.8
1,500	....	....	....	7.5	....	2.9
2,000	....	....	....	8	....	3

Whenever k_{11} can be made larger than given in the above table without reducing the percentage of the polar embrace below its practical limit, it is advisable to do so, and in fact, this ratio in some modern machines has values as high as $k_{11} = 12$.

(To be continued.)

A Poetical Warning.

According to London *Lightning*, a recently appointed assistant manager in a central station posted up the following notice:

NOTICE TO ENGINE DRIVERS.

One hot bearing!
A hard swearing!
Two!
Adieu!

Temperature of the Ocean.

The temperature at the bottom of the Atlantic Ocean, as determined by the resistance of the Atlantic cables, is said to be 2.8° C, which is a mean for the whole year. That at the bottom of the Mediterranean, measured in the same way, is said to be 13.8°.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir: Reading the very interesting and instructive correspondence which your later issues have brought out, relative to the breaking of fly-wheels, I note that one of your writers states, on page 500, apparently controverting my own earlier statement, that the cases which I had known were those of engines with detachable gear, in which some defect had occured in the governor or its connections.

I had no intention of denying the liability to accident of engines with positive motion gears, and had seen accounts of the cases which he quotes, In the latter instances, however, I had not usually, known enough of the individual cases to judge precisely what was the cause of the disaster. My point was that the majority of the cases in which the cause was indisputably discovered, were instances of defective governing primarily. The difference between the detachable gear and the positive motion shaft system of governor and gear is that the accident to the governor of the former throws the steam into the engine full-stroke; while in case of accident to the latter, the steam is usually shut off entirely; with the former a "runaway" is the natural and probable result, with the latter a sudden stop.

With defective wheels no class of engine is absolutely safe; but the large wheels of slow engines are more liable to serious and dangerous defects; they usually govern less closely, and hence, if at or near the danger line at normal speed, they are more liable to pass it even without accident to the governor; they are more sure to reach it if such accident does occur. The high speed engine, with shaft governor, is likely to have a sounder, because a smaller, wheel, on the average; it usually governs more closely, and is thus more certain to keep inside any near limit of strength of wheel, and, in case of injury to the governor, as a rule, unquestionably, reduces danger to zero, instead of exaggerating it.

Mr. Flather, on page 498, refers to what I have no doubt is a not

frequent source of danger and an occasional cause of accident—the shrinkage strains, which always exist, to some extent, and often to a serious and dangerous extent in large castings. It is but a short time since I saw a high-speed engine, in a light and power station, working, apparently, to the satisfaction of the manager, with one arm of its wheel broken, and the faces of the break visibly separated, by its own shrinkage-stresses. It was finally removed, but not until a new wheel was made and received from the builder, some time after the break was discovered; meantime, the wheel had done good duty, in its fractured condition, on a very trying street-car system. No one would be likely to advise this sort of risk being taken; but the fact illustrates the case well, and shows how enormous must sometimes be these internal stresses and strains in castings too rapidly or irregularly cooled, or when badly designed.

I once designed a 16-foot fly-wheel, in halves, for a Greene engine; it was cast some time before it was needed, and was stored in the yard one midwinter day, where it lay in shadow in the early morning, in sunlight at noon. One bright, cold morning, when the sun shone clearly and its rays were unusually warm, the half-wheel lying on top its mate, and probably very cold, received the full heat of the sun's rays, as the shadow swept off its rim, and, after an hour or so, the exact time was not known, the centre and arms dropped out of the rim, with a sharp report, and the wheel was ruined. It had been cooled at the foundry too rapidly. Had it been set at work it is possible that the added load would have been just sufficient to inaugurate a wreck. Norman Wiard, in promulgation of his ideas of ordnance construction, used to place before the committees of Congress castings designed in such manner that they would inevitably be broken by these shrinkage-stresses.

In another case we fitted a heavy engine with a cast iron crank. It dropped off, broken at the hub, the first time the engine turned over. A new crank from the same pattern, but with special care taken in cooling in the foundry, was put in its place, and is running, I presume, to-day, having performed years of service.

It must not be supposed that I would advocate discarding the detachable gear, and the universal use of a positive-motion system, with a shaft governor. A throttling engine is probably more subject to this danger than either of the others; but I have often advised its use, and have designed such engines for special purposes. What I would advise, however, would be the construction of large wheels for such engines, as is, in fact, usual, in segments, and the taking of special precautions, as by insuring a very heavy head of metal when pouring them, and by as slow cooling as is customary with cast iron ordnance, to insure soundness and freedom from shrinkage-stresses. Some safety device should be employed with all such valve-motions to insure shutting off steam at a fixed and safe limit of speed, and all possible precautions in design, as well as in construction and operation. These precautions, however, would not be out of place with any class of engine.

I presume that defective castings are responsible for many breakdowns; but the stronger the wheel, the worse the wreck when a runaway does happen, and insurance against overspeed and defective regulation must be the main reliance as a preventive of the majority of these startling, costly, and often fatal accidents.

Ithaca, N.Y. R. H. THURSTON.

To the Editor of The Electrical World:

Sir: The letter of Mr. Coykendall calls attention to the stresses induced in a fly-wheel by sudden application of a large load to the engine, and the sudden removal of the same. The serious character of this stress has, I think, been long recognized by engineers, and provision is usually made to make the wheel sufficiently strong to resist the action of centrifugal force and also the stresses due to sudden application of the load.

I have seen no exact statistics relating to fly-wheel accidents; I know that such accidents occasionally happen, but it is my belief that considering the number of steam plants in use, the percentage of fly-wheel accidents is not greater on engines driving machinery for electric railroads, than on mill and factory engines. These accidents have been more or less common ever since the use of the steam engine,* and I do not consider the percentage greater than heretofore. This again leads me to think that the stresses referred to are as a rule well considered and provided for by builders of engines for street railway purposes.

The two forces which act to destroy fly-wheels may be considered as centrifugal force and inertia. When the fly-wheels are used as belt wheels an additional force equal to the difference of tensions on the two sides of the belt, exerts a transverse strain on the arms, and tends to flex and rupture them. This force suddenly and intermittently applied may induce a vibration which in connection with centrifugal force tends to rupture the wheel.

Approximately the centrifugal force depends only upon the radius, angular velocity and specific weights of the material.* For cast iron moving with a lineal velocity of V feet per second, the centrifugal force $= 0.0971\ V^2$ per square inch of section of rim. So that the stress in fly wheel per square inch of rim due to centrifugal force, would be as follows:

Velocity of rim, feet per second...	30	40	50	75	100	150	200
Centrifugal force, per sq. inch....	87.4	155.3	242 8	546.3	971 0	2185 2	3,884 0
Velocity of rim feet per minute ..	1,800	2,400	3,000	4,500	6,000	9,000	12,000

As the breaking strength of cast iron is from 16,000 to 22,000 pounds, it is seen that the limit of strength is not reduced until the velocity of rim reaches about 400 feet per second, or 24 000 feet per minute. Allowing a factor of safety of 5, the greater safe speed is reduced to 200 feet per second, at which velocity small wheels could no doubt be run safely.

The strains on the arms of the fly-wheel are caused by variation in speed, in which case the inertia of the wheel tends to produce transverse rupture; also by the transmission of the load from axle to periphery which produces a strain of the same nature.

These forces tend to flex the spokes, and if the sum of these transverse forces is too great, rupture of the arms is the result.

As the twisting movement is transmitted from the rim to the shaft of the arms, it is evident that these jointly should be of strength equal to that of the shaft. If the shaft is of wrought iron, the arms of cast iron, this condition will be brought about when the stress in the shaft is one-fourth of that in the arms.* If Z represents the modulus of section of the arm, d the diameter of the shaft and n the number of arms,†

$$\text{Then } Z = \frac{4\ d^3}{5\ n}$$

The value of Z for simple sections would be as follows:

Rectangle $Z = \frac{1}{6}\ bh^2$; $b =$ dimension at right angle to plane of wheel.

Circle $Z = 0.0982\ d^3$; $d =$ diameter of arm.

Ellipse $Z = 0.0982\ ba^2$; $b =$ axis at right angle to plane of wheel.

Table giving Dimensions of Arm, Equal in Strength to Shaft.

Diameter of Shaft.	Diameter of Circular Arm.	Axis of Elliptical Arm.	No. of Arms.
4	4 01	2× 5.6	8
6	6 06	3× 8 5	8
8	8.08	4×12.8	8
10	10.01	5×14 2	8
12	12 01	6×17.0	8
16	16 02	8×-5 6	8

This letter has no doubt taken a line somewhat foreign to that suggested by Mr. Coykendall, the desire being to show that the stress to which he refers is one that has never been neglected in a good design, and that a fly-wheel properly designed is safe so far as centrifugal forces are concerned and equally strong in arms and shaft.

The accidents which have come to fly-wheels are much varied in their nature; usually they are due to accident to the governor which permits the speed to accelerate to such an extent that the centrifugal force becomes sufficient to rupture the wheel; oftentimes they are due to defects in materials or to faulty construction of the wheel itself. In one case, with which the writer was acquainted, the accident was caused by a defective shaft.

If the arms of the wheel are made light, if the load is such as to cause considerable variation in speed, the accident may begin by breakage of the arms. In many wheels, especially large ones, molecular strains, due to unequal cooling at the time of casting, often exist, and the arms frequently are in a state of high tension and ready to give at the first severe strain. Such wheels are always a source of danger, and a menace to life, limb and property. While it may not be possible to determine the force which may be stored in by molecular strains existing in the cast iron arms by ordinary inspection, still the writer believes that a close examination at frequent intervals, would often detect flaws and imperfections which later might cause serious accidents. Sectional or built-up wheels are free from molecular strains and less likely to disintegrate than solid ones, but otherwise are not so strong. Large wheels of necessity must be constructed in this way, and for many years, 88 feet per second, or one mile per minute, has been considered about the highest safe limit of peripheral velocity. This limit has been exceeded in several instances, but recent fly-

*See paper by Herr Kochy, in the "Verhand des Vereins zur Beforderung des Gewerbfleisses," in 1886.

*Unwin Machine Design, Vol. II.

†Unwin's Machine Design, Vol. II., page 186.

wheel accidents indicate that we have not yet learned to build so strong that we can safely establish a higher limit.

The accidents with fly-wheels have occurred with that class of engines having slow rotative speed more frequently than with the high speed engines. This may be due to two causes; one, the need of a large driving pulley, which is more difficult to construct than a small one; second, the same absolute variation or increase of a given number of revolutions in speed causes proportionately a greater increase in centrifugal force in the slow speed than in the high speed engine. It is also quite certain that the governors applied to high speed engines are in general less liable to accident and regulate closer than those applied to the other type of engine. It should not be overlooked, however, that nearly all the heavy and powerful engines are of the slow speed class, and larger strains must be met in the fly-wheels.

This letter states quite fully my ideas regarding the general subject introduced by Mr. Coykendall, although for the reason stated other points relating to the failure of fly-wheels have been considered. I may say in conclusion that while I think every precaution should be adopted, in the way of design, construction and inspection, to prevent fly-wheel accidents, I do not think present practice to be such as to cause alarm, or misgiving, or lack of confidence in the engines now constructed by our best builders and used for driving railway generators.

Ithaca, N. Y. R. C. CARPENTER.

To the Editor of The Electrical World:

Sir:—I would like to add a word to the already extensive discussion on "Fly-wheel Accidents," in your columns. A large number of more or less plausible theories have been advanced for the breaking down of fly-wheels under conditions of an overload suddenly thrown on the engine, but it is doubtful to my mind if many of them will hold good for a wheel that is properly designed. Such a wheel will not be overstrained by any amount of steam admitted into the cylinder under the conditions given. I agree with Mr. Emery in saying that such accidents are due altogether to excessive speed, though not necessarily involving improper action of the governor.

There is another and, I think, potent cause for such accidents in railway power houses.

A common practice in the construction of such plants is to drive one or two dynamos from one engine, the plant consisting of two or more such units, with all dynamos in multiple. With such a combination it is possible through careless handling of the generators, or through accident, to cause any one of them to run as a motor, taking power from the other generators in multiple with it. Such a motor, if the field is weakened sufficiently by increasing the shunt resistance or breaking the shunt circuit altogether, which may happen, will easily attain power and speed high enough to be dangerous, not only to the fly-wheel of the engine coupled to it, but to its own armature and the armature of its sister dynamo. Under such conditions the engine governor is powerless to check the increasing speed, once the balls have reached their extreme outer position.

It is easy to imagine how such a thing could occur in the average power station. Suppose the load increasing, and it becomes necessary to put in a fresh unit. The engine is brought up to speed. The dynamo attendant adjusts his voltage to that of line (or thinks he does). But it so happens that the E. M. F. of the fresh dynamo is too low when he closes the switch. The result is a large deflection on the ammeter. The attendant, unless he is cool-headed, immediately adjusts his shunt rheostat violently, and most likely will turn it the wrong way. By this time there is a squealing of belts, the ammeters are demoralized, and the man crazy. As a last resort he will throw the switch on the face of the rheostat and break the shunt circuit through the lamps. (Why dynamo builders put a switch in the shunt circuit is more than I can understand. It is a source of the greatest danger, and altogether unnecessary).

When this switch is thrown the armature acts as a short circuit of low resistance through which the other dynamos send a powerful current and the violence with which such an armature gathers speed can hardly be imagined by any one who has not had an experience of this kind. A great many switch-boards, especially the boards built some years ago, are very deficient in their equipment of instruments. It is a common thing to throw dynamos in multiple by noting the relative brightness of the pilot lamps. Frequently even this precaution is neglected, and guesswork alone used. Under such circumstances it is a wonder so few accidents of this kind occur. R. FLEMING.

U. S. Navy Yard, N. Y.

Designing Electric Light Stations.

To the Editor of The Electrical World:

Sir: Why is it that when an electric light company is organized, the first thing they do after receiving their charter is to secure the services of an architect to draw up plans for the plant? Do you suppose that if a man needed a pair of shoes, he would get a carpenter to make them for him? Practically it amounts to the same thing.

But this is not the worst of it. Quite often, when a company finds it necessary to build a larger station, they get an architect to make plans for the building after the idea of the president, secretary or manager of the company, who are not electricians or mechanics, and know nothing of the requirements of such a building.

The writer of this was recently called upon to take charge of an electric light plant as superintendent and electrician. The plant was intended to be operated by water power, but had a steam engine and boilers, to be used in case of scarcity of water. The chimney was at one side of the dynamo room, and the enigne was placed right next to the chimney.

I noticed that when the engine was running the slight lateral motion of the main driving bolt caused it to run against the chimney. Inquiry elicited the fact from the engineer that if the original plans had been followed the chimney would have had to be cut away fully eight inches to allow the passage of the belt. The mistake had been discovered too late to permit their doing more than moving the engine out just barely enough to allow it to be run as stated above. Measurements for the foundation of the engine, shafting, etc., had been made by the secretary of the company, who, although an excellent secretary, could not by any stretch of the imagination be called a mechanic or an electrical engineer.

I might also state that while the dynamo room was a model of neatness, and furnished with the best of electrical apparatus and appliances, the soul of the plant—the boiler room—was about one of the worst holes I have ever come across. The boiler room and coal shed were one room, and there being only capacity for about 30 tons of coal, when a car of coal was unloaded the fireman had to crawl about over the coal pile to do his firing.

This is only a sample of several plants of the kind that I have seen. How much money and trouble could be saved if when a company is preparing to erect its plant, it would secure the man who is to have charge of the plant when finished, and let him design the plant, or else engage a constructing engineer for that purpose.

Cincinnati, O. C. H. CARTER.

Signalling Through Space.

To the Editor of The Electrical World:

Sir: I notice in your issue of Nov. 17, an article on the above subject by Mr. Thos. D. Lockwood.

Some time ago, in a small city in Maine, I was experimenting with a set of magneto telephones, using as a circuit, one side of the alternating electric light mains (at that time dead), and the ground as a return. There was no telephone line within a distance of two hundred feet, and, at times, I could distinctly understand parts of conversation which, I afterwards learned, was carried on over the telephone company's lines in that place.

As there was no possible chance for connection between the two circuits, this was evidently an example of induction, and there seems but little doubt that some time in the future, we will be able to converse with cities some miles distant, without any electrical connection whatever.

New York, N. Y. BENJ. O. ELLIS.

Continuous from Alternating Currents.

To the Editor of The Electrical World:

Sir: I have 300 cells of gravity battery and by a very simple arrangement can pass the full current through the primary of an induction coil and produce a direct current in the secondary circuit. Would a direct current dynamo give the same result as the battery, and if so, would it have any commercial value for long distance transmission? ELECTRICIAN.

New York.

[The character, not the origin, of the current, is the point always to be considered, and in this respect there is an identity in the case referred to. Such an arrangement, if practical, would have a considerable value for various purposes. Several different methods have already been devised to produce continuous from alternating currents, notably that of Pollak, described in The Electrical World of August 5, 1893, and later in a paper read before the International Electrical Congress at Chicago.—ED.]

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Cathode Rays.—An editorial in the Lond. "Elec. Rev.," Nov. 2, reviews an article by Mr. Poincaré on the recent investigations of Lenard on the properties of cathode rays. He believes that the experiments show that the theory of Crookes regarding radiant matter—according to which the rays consisted of molecules of gas whose free path had been enormously extended by the rarefaction of the gas—was false and they also throw considerable doubt on the validity of the kinetic theory of gases. Mr. Lenard's experiments showed that the cathode rays could be generated only in a highly rarefied media, but would propagate themselves in a different medium like air at atmospheric pressure; when they were intercepted by glass they would not pass through it, but they would pass through a sufficiently thin piece of aluminum foil about 0.0025 mm thick; the thinness of the plate is the only essential condition, as conductors and dielectrics then behave alike; they show that the hypothesis of radiant matter is entirely at fault; the rays do not propagate themselves in a straight line but turn round opaque bodies; the degree of permeability of different gases was measured at different pressures; the degree of disturbance is due only to the density of the gaseous medium, its nature not being of any importance; cathode rays correspond to luminous rays of different colors and differ in their capacity for generating phosphorescence; a magnet acts as a prism which separates the different rays; the deviation of the same beam is the same in all cases and under all pressures; the phenomena is due to the luminiferous ether; the disturbance which the molecules produce depends on their mass alone.

Waves on Iron Wires.—A paper by Mr St. John on "Wave Lengths of Electricity on Iron Wires" (Jefferson Physical Laboratory) is contained in the "Phil Mag." for November. He investigates the question whether the magnetic qualities of iron are called into play under extremely rapid alternations of the magnetizing forces; he describes experiments made by himself and comes to the following conclusions: "The self-induction of iron circuits is greater than that of similar copper circuits under very rapid electric oscillations (115×10 to the sixth power, reversals per second). The change in self-induction varies from 3.4 to 4.3 per cent. in the present investigation and decreases with decreasing diameters. The increase in self-induction produces greater damping and a shortening of the wave length of 1.5 to 2 per cent. The permeability of annealed iron wire under this rate of alternation is about 385. For oscillations of the same period the wave length along parallel copper wires varies directly with the diameter of the wires. The maximum decrease observed in 5 per cent."

The same issue contains a paper by Prof. Trowbridge, "On the Change of Period of Electrical Waves on Iron Wires;" he states that his results were confirmed by those of Mr. St. John (in the above paper), who has shown by an entirely different method that the wave lengths sent out by the Hertzian vibrator on iron wires differ in length from those transmitted on copper wires of the same geometrical form as the iron wires.

Elliptically Polarized Rays.—A short article by Mr. Zehnder from the "Wied. Ann.," No. 11, 1894, is published in the Lond. "Elec.," Nov. 2. Elliptically and circularly polarized rays of electric force were to be obtained by two wire gratings, like those employed by Hertz by a process described in the article.

Energy of the Amperian Molecule.—A paper by Prof. Chattok and Mr. Fawcett is contained in the "Phil. Mag.," for November; they describe experiments undertaken for the purpose of determining if possible whether the molecular currents of ampere are accompanied by motions of the molecules themselves, and conclude among other things that "if the molecular currents are due to a spinning motion of ionic charges, this motion is not inseparably connected with the spinning of the molecules themselves."

Self-induction of a Ring.—A paper by Mr. Hicks is contained in the "Phil. Mag.," for November; he solves the problem by means of toroidal functions and comes to a conclusion which does not seem to have been noticed before; the paper is highly mathematical in character.

Thermo-couples of Metals and Solutions.—An article by Mr. Hagenbach is abstracted at some length in the "Elektrochem. Zeit.," for November; he gives the results of a number of investigations

Surplus and Deficit Theory of Electricity.—The article by Mr. Maycock is continued in the Lond. "Elec. Eng.," Nov. 2.

MAGNETISM.

Magnetizing and Astaticizing Galvanometer Needles.—A new, simple and very effective method is described with illustrations, by Mr. Wadsworth (of Washington) in the "Phil Mag.," for November. He states that the sensitiveness of the galvanometer depends on the method of magnetization to a much greater degree than is usually supposed and by using this new method the sensitiveness may be doubled and in some cases more than quadrupled. The method consists essentially of placing the completed frame carrying an unmagnetized needle in two opposite air gaps of a single magnetic circuit, of a rectangular shape with coils surrounding two of the sides, the needles being in the air gaps; the two air gaps being both in the same magnetic circuit, the fields in them are necessarily of precisely the same strength for all magnetizing forces, which is an essential condition for securing astaticism; the strength of the field should be suddenly increased to a maximum and then gradually decreased several times in succession, by varying the current, or better by varying the distance between the two poles and tapping the support with a light hammer when the magnetic induction is at its maximum, but in no case should the current be broken suddenly when the poles are close the needle or the strength of the latter may be very considerably weakened, if not totally destroyed; he describes the method very fully, giving also other precautions; in one case the sensitiveness of a galvanometer was increased fully ten times by remagnetizing in this way; another advantage is that in the construction only unmagnetized needles have to be handled.

Conductivity of Bismuth in Magnetic Fields.—A paper by Mr. Henderson, accompanied by a number of tables and plates of curves is given in the "Phil Mag.," for November. He gives a review of the subject with reference to previous publications and describes his experiments made to determine definitely the relation between the magnetic field and the resistance of bismuth wire, carrying it to much higher field intensities than have heretofore been used, and also to determine the influence of temperature on this relation, which influence is quite great and for exact determinations, it must therefore be known; a spiral of copper or platinum, side by side with the bismuth spiral, can be used to determine the temperature by the change of its resistance; the tables and curves appear to be very complete and are probably the most reliable that have been published; the intense fields were produced by the magnet of Prof. du Bois.

Changes of Length Due to Magnetization.—The results of some experiments by Mr. Nagaoka from the "Wied. Ann.," are given briefly in the Lond. "Elec.," Nov. 2. The experiments were made with iron nickel and cobalt; their behavior was fundamentally different; in the iron the length increased gradually at first with increasing field intensity, then more rapidly, reaching a maximum at 240 C. G. S. units, after which it fell below its original value, having reached the latter at 305; the maximum elongation was between four and five millionths of the length; the nickel showed no elongation, but a shortening approaching a limiting value at higher intensities; cobalt showed an exactly opposite behavior to iron; for all three metals the change of length appears to have an approximately linear relation to the square of the magnetization.

Leakage Between Conical Poles.—In the "Elek. Zeit.," Nov. 1, Dr. Weber gives an illustrated description of the application of the Quincke method for determining the value of the field between the poles of powerful electro-magnets ending in slightly truncated cones; he shows that this field is not uniform as is often supposed and gives the results of some measurements; the method is based on the action of the field in liquids in capillary tubes.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Inductance in Aerial Lines.—In the mathematical article by Prof. Blondel begun in "L'Eclairage Elec.," Oct. 20, he deduces the formulas for polyphase currents and compares the different alternating systems with respect to the inductance, a comparison which, he says, has not yet been made; he discusses, first, monophase lines, then polyphase lines, giving the general and the particular formulas.

Measurement of Compounded Resistances.—In a mathematical article by Mr. Campbell in the Lond. "Elec.," Nov. 2, he deduces a solution for the following case: In measuring the insulation resistance of the two leads in the wiring of a house, three measurements may be made, first from lead to lead, and then from each lead separately to earth; in some cases the former is equal to the sum of the two latter, but this is by no means necessarily the case, which he shows by an illustration; he then solves the general case of three resistances inseperably connected in the form of a triangle, in which it is required to find each of the resistances from the measurements taken between each of the three junctions; he gives both the algebraic and a simple graphical solution and shows that the real resistances are greater than the observed, giving the formulas. He shows how these solutions may be applied to any three or more resistances joined permanently in series in closed circuit when only the junctions are accessible, thus the resistance of

each separate coil of a closed circuit armature may be found by means of an ammeter and a voltmeter, an illustration of which is given.

Localizing High Resistance Faults in Submarine Cables.—Mr. Taylor, in the Lond. "Elec. Rev.," Nov. 2, replies briefly to Mr. Jones' article (see Digest last week), but intimates that it is tedious and impracticable, as the time for making such observations is of necessity very limited.

Photometric Units and Quantities.—In the abstract under this heading in the Digest last week, the following typographical error occurred: the letter **Q** should be inserted before the expression "for quantity of light of lighting" near the end of the paragraph.

Symbols.—The Lond. "Elec. Rev.," Nov. 2, replies editorially to the remarks in The Electrical World of Oct. 13, regarding Prof. Jamiesen's criticism; it claims that the matter is still open for discussion as the Congress did not adopt the Hospitalier system, but merely recommended it; it also claims that the discussion was not a truly international one.

Registering Ampere and Voltmeters.—An illustrated description of a new form containing a d'Arsonval galvanometer and a revolving drum, is illustrated and described in "L'Energie Elec.," Nov. 1.

Meter.—A well illustrated description of the Continental Co.'s meter, is given in "L'Eclairage Elec.," Oct. 20; it consists essentially of an electric dynamometer and an electric motor, a damping cylinder and an integrator.

Ayrton-Mather Galvanometer.—The new form already mentioned in these columns, is described and illustrated in the Lond. "Elec. Rev.," Nov. 2; it is based on the d'Arsonval principle.

Government Standardizing Station at Switzerland.—According to the Lond. "Elec.," Nov. 2, the question of establishing a State electrical standardizng and testing station in Switzerland, is under consideration.

Board of Trade Laboratory.—The Lond. "Elec. Rev.," continues its description in the issue of Nov. 2, in which the pressure standard (already mentioned in the Digest) is described and illustrated.

DYNAMOS AND MOTORS.

Design of Large Alternators.—In the Lond. 'Elec. Rev.," Nov. 2, Mr. Armstrong (of Schenectady) replies to the recent article of Mr. Kennedy (see Digest, Oct. 20). He states that at the present day the alternator is better understood and can be designed with a greater degree of accuracy than the continuous current machine; the advantage of one type over another in regard to efficiency need not be discussed as one may be made as efficient as the other, but with regard to the life efficiency there is a great divergence; a machine should be constructed to stand all the excessive strain and short circuits involved in commercial work, especially in parallel running now so generally practiced; he divides them into two classes, those with low and those with high armature inductance; a disk armatnre has little or no inductance, but will have a very strong synchronizing power when running in multiple, but if, from any cause, the field circuit of one machine becomes broken, the current rush through its armature will be enormous and practically destroy it; the regulation of the field current will require very close attention to prevent a large cross current and a dropping out of phase; throwing into synchronism will also require great care. With an armature having a sensible amount of self-induction the rush of current on falling out of step will be limited to perhaps double the normal, which will not be dangerous, and a breaking of the field need not throw it out of step, as the variation between two fields of an ironclad machine running in multiple can be varied within wide limits without interfering with their keeping in step; the best machine is the one having a fair amount of armature inductance; the ironclad construction also gives a good driving support to the armature wire and protects it; another argument in its favor is that there are on the market to-day only one or two types of machines using armatures without iron. He takes exception to some of Mr. Kennedy's statements; cast iron can never be worked to advantage higher than 6 kilogausses, while laminations are worked at double this amount and require only one-fifth the ampere turns to force this flux through the iron, representing a saving of one-half the weight; the cost of the laminations is about 1.4 times that of cast iron, so that the gain is about 25 per cent over cast iron; a well designed ironclad machine will have about 15 per cent leakage, while in the Mordey form the leakage will be much more, for reasons which he gives; the mechanical design of the flat ring type is too fragile for commercial use, the eddy currents in the armature coils and poles are excessive and not well avoidable, while the low self-induction prohibits its use for commercial work with multiple running.

Non-synchronous Motors for High Voltages.—In a short article by Mr. Kolben in the "Elek. Zeit.," Nov. 1, he states that in large transmission installations with high tension, it is preferable in general, to use transformers with the smaller motors, while the larger ones are connected directly to the high tension line, provided the part of the motor containing the high tension currents is not in motion; for large installations synchronous motors were, however, generally used heretofore, partly because the construction of large non-synchronous motors had not been sufficiently developed, and also on account of the large excitation current, but it has now become possible to overcome these objections by careful construction, proper disposition of the windings allowing for only a small leakage, and chiefly by the proper proportioning of the parts; such motors are now made with a high efficiency down to a tenth of their load, they are not sensitive to variations in the voltage and speed of the primary machine, and have the advantage that the continuous current excitation is no longer required; the power factor, that is,the relation between the true and the apparent watt consumption, is not as favorabl ewith non-synchronous as with synchronous motors,but the difference becomes almost nothing at full load. To show the difference between these two styles of motors,he gives curves for an 80-hp synchronous and a 100-hp non-synchronous three-phase motor, both for high tension, built by the Oerlikon Company, the curves giving the power factor, the efficiency and the current for all different loads; the curves show that the power factor of the synchronous motor is more favorable for all loads, but at full load it is only 0.94 as against 0.86; the efficiency of the non-synchronous motor is higher for all loads, the curve being similar to that of a good transformer, the value at full load being 91 per cent. as against 86 per cent. for the synchronous motor.

Alternating Current Motors.—The continued article by Mr. Jacquin on the Lyons Exhibition, in "L'Eclairage Elec.,' Oct. 20, is devoted chiefly to the description of the alternating current motors, including the monophase and biphase motors of Brown.

ARC AND INCANDESCENT LIGHTS.

Lantern Arc Lamp.—The automatic lamp called the "Planet," is described and illustrated in the Lond. "Elec. Rev.," Nov. 2, and is spoken of very highly.

Key Socket and Lamp Holder.—A new form of the one adopted by the Edison Company is illustrated in the Lond. "Elec. Eng.," Nov. 2.

Silvering Bulbs.—A receipt is published in the "Elek. Tech.," Oct. 31.

ELECTRIC RAILWAYS.

Budapest Underground Railway.—The "Elek. Tech.," Oct. 31, publishes at some length a description of the engineering features of this road which is at present being constructed. It does not run in deep tunnels like the electric underground line in London, but in an underground passage directly below the street pavement, the bottom of the tunnel being no lower than the foundations of the buildings; the length is nearly two miles,the steepest grade is 15.28 per cent. and the sharpest curve has a radius of about 125 feet; the platforms for the stations are ten feet below the streets, requiring only nineteen steps to descend and will have a length of two cars; the inside height of the tunnel is about 8¾ feet, the width 9.2 feet; the roof for the double tunnel is supported in the middle by iron pillars, the width of the double tunnel being about 20 ft.; the bottom of the tunnel is 11¼ feet below the pavement; a special drain pipe will be laid along each of the two sides of the tunnel to drain off the water; on the street on which it is to be laid there are no gas or water pipes in the space to be occupied by the tunnels; the sides of the tunnels are to be made of Portland cement, the bottom of hydraulic cement and the top of cement worked on cross beams resting on the pillars, which are about 13 ft. apart; the work is carried on at two places. The conductor for the current will consist of angle irons supported on insulators on the sides of the tunnel near the bottom, the rails serving as a return circuit; the cars will fill nearly the whole space of the tunnel and will be supported at the two ends on pivoted trucks on which the motors are placed; the inside of car will be 6.8 ft. high, 7 ft. wide and 25 ft. long; it will be divided into three compartments, the two end compartments being reserved for ladies and for those who do not smoke, while the middle compartment is for smokers;—the middle compartment only has sliding doors, one for entering and the other for leaving the car; a car will seat 28 persons and will carry 40; the cars will be lighted with incandescent lamps and the walls will be decorated with mirrors to give the appearance of a large room and to increase the effect of the lights; every car is to have a ventilator, which will operate automatically only when the car is at stations; each car is provided with an apparatus indicating the name of the next station.

South Staffordshire Electric Railway.—A paper by Mr. Dickinson (the inventor of the side trolley system used on that line) is published in part in the Lond. "Elec.," Nov. 2; the most interesting feature to Americans, namely the side trolley arrangement, is omitted in the reprint, it having been described in that journal Nov. 18, 1892. The line is said to have presented many difficulties on account of grades and curves; it replaces a steam line; the trolley wire is suspended at a height of 21 ft. above the road at varying lateral distances from the car not exceeding 13 ft.; a trolley switch is shown and described. From a table giving the data for a number of different English roads, the total cost of running per car mile of this road was 8.12 cents, and the average cost of fuel was .96 cents per car mile; the fear that the amount of wear and tear on the trolley wire would be great was not substantiated, for after fourteen months it was scarcely possible to measure it.

Liverpool Railway.—The article in the Lond. "Elec. Rev.," mentioned in the Digest last week, is concluded in the issue of Nov. 2.

Accumulator Traction.—Acccording to Dr. Stricker, in the "Elek. Zeit.," Nov. 1, a commission of experts is to make a test of the Waddell-Entz copper-zinc accumulator system in Vienna, the tests to begin about the end of November.

Canal Boat Propulsion.—An illustrated description of the Galliot system, described in the Digest Nov. 3, is given in the Lond. "Elec. Eng.," Nov. 2.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Central Station Statistics.—In a recent paper by Dr. Von Stephan, he states that on Oct. 1 there were installed in Germany, exclusive of Bavaria and Wurtemburg, 6,020 installations, of which 5,830 were chiefly for lighting, the number of incandescent lamps being about 1,005,000 and arc lamps 48,715; 64 installations were used for electrolytic purposes and 232 for transmission of power; 353 installations used alternating currents and 19 three-phase currents.

Central Stations in Europe.—A short abstract of the recent summary in "L'Ind. Elec.," mentioned in the Digest last week, is given in the Lond. "Elec. Eng." Nov. 2.

Bolton.—The greater part of the issue of the Lond. "Elec. Eng.," of Nov. 2, is devoted to a long and profusely illustrated description of this station which was recently opened; the illustrations are chiefly of the architectural features of the station; the alternating system is used, the station being apparently at the extreme end of the town; 2,000 volts are generated at the station and are transformed down to 100 volts at transformer sub-stations, feeding into the low pressure distributing mains, where there is a scattered demand house transformers are used.

Calais.—A translation of the description of the plant mentioned in the Digest, Nov. 3, in which alternators were coupled directly with gas engines, is published in the Lond. "Elec. Eng.," Nov. 2.

Agricultural Installation.—A brief description with illustrations of a plant installed on a farm in Austria is given in the "Elek. Zeit.," Nov. 1.

Gas Engines.—An article containing the data of a number of comparative tests of different machines is published in "L'Energie. Elec.," Nov. 1. The same issue contains also a short article from the German on the incrustations in such engines.

WIRES, WIRING, AND CONDUITS.

Electricity in Mining.—Mr. Berthon's article (see Digest last week) is continued in "L'Elec.," Oct. 27; he discusses at some length the wiring and accessories, giving many useful hints and recommendations; the article does not admit of being abstracted briefly; in general, however, he recommends concentric cables, the complete avoidance of all joints, the complete renewal of a cable if broken, the use of a number of leads in parallel so that an injury to one may be repaired more readily, placing the cables in conduits of wood or iron, using no greater lengths than 1,200 to 1,500 ft., the use of fusible plugs only outside of the mines or in cases containing compressed air or oil, at least for mines containing fire damp and the absolute prohibition of the use of an earth return. He describes the Atkinson, Charlton and the Nolet systems of safety cables for mines containing fire damp, the general principle of which is that the breakage of a cable causes an arc to be formed where it cannot ignite the fire damp; the latter form of cable proved itself to be very effective. Cages for the incandescent lamps are described and illustrated.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Railway and Telephone Circuits.—An editorial in the "Elek. Zeit.," Nov. 1, discusses the importance of making tests to prevent railway circuits from interfering with telephone circuits and suggests the introduction into the railway circuit, of a choking coil as required by the British Board of Trade; it seems that this device has not yet been tried in practice.

Induction System.—An editorial in the "Elek. Zeit.," Nov. 1, states that after studying the system suggested by Messrs. Preece and Stevenson, Mr. Rathenau devised a system for communicating across bodies of water by a conduction system but without the use of metallic connection; experiments gave more satisfactory results than were expected; the distance was three miles.

Photographic Recording of Telegraph Signals.—The Lond. "Elec. Rev.," Nov. 2, abstracts a description from a photographic journal of a moderately simple instrument which is inserted in a circuit running parallel to the telegraph wire for a short distance, and which records photographically by means of the action of an electromagnet on a mirror, the telegraphic signals on the line. It is suggested editorially that it could only be used with a single wire line, which for important telegraphs is said not to exist in that country; when a single line is duplexed this system of tapping could not be used.

Railroad Signals.—The Patenall system used in the tunnel of the New York Central Railroad is described and illustrated in the "Elek. Zeit.," Nov. 1.

ELECTRO-CHEMISTRY.

Chemical Theory of Accumulators.—The article by Mr. Wade is concluded in the Lond. "Elec.," Nov. 2. He discusses chiefly the question of the heat evolved in the cell and the difference between the charging and the discharging E. M. F.; the latter should be the same if the accumulator reactions in the one were exactly the reverse of those in the other, but in practice this never happens, as there is always a considerable difference even after allowing for the internal resistance; some curves by Prof. Ayrton are given, from which it appears that for about two-thirds of the charge the E. M. F. is higher than that of the corresponding periods of discharge, by a practically constant amount of about 0.14 volt. but from this point onwards the difference continually increases; he shows that this cannot be ascribed to the rapid accumulation of the liberated sulphuric acid in the electrodes, as the same thing is true in the Groves gas battery; he shows that according to Berthelot, persulphuric acid (containing half as much hydrogen as sulphuric acid) is the primary product at the positive electrode when sulphuric acid is electrolyzed, and he believes that it is this reaction which causes the higher E. M. F., as its formation is accompanied by an absorption of energy and its decomposition by a liberation of energy; as it is an unstable compound it immediately undergoes decomposition, reacting with water and liberating oxygen, part of its energy being restored to the circuit and part being transferred into heat; the difference between the two curves mentioned above is really a measurement of the persulphuric acid formed. Some curves by Ayrton and others are given showing the rise of temperature during the charge and the discharge, and they are discussed at some length. It is believed that there is not much probability or possibility of doing away with the wasteful reaction in the formation of persulphuric acid; some of the heat it is thought is due to imperfect diffusion.

Some Phenomena of Electrolysis and Polarization.—The paper from the Italian by Mr. Martini is abstracted in "L'Eclairage Elec.," Oct. 20; he describes experiments with the electrolysis and with small electromotive forces, of films of liquids extending between two wires.

Testing Baths.—The article by Dr. Kreuger (see Digest, Oct. 27) is continued in the "Elektrochem. Zeit." for November; he describes rapid and simple methods for determining the constituents of a bath by a titrimetric analysis, in which the constituent of a bath is determined by the volume of another solution which must be added to produce certain effects.

Anodes for Electrolysis of Alkaline Cholorides.—In reply to a correspondent to the Lond. "Elec. Rev.,"Nov. 2, it gives a brief description of the manufacture of lithanode plates.

The Limits of Electrolysis.—A paper by Dr. Bein is contained in the "Electrochem. Zeit.," for November.

MISCELLANEOUS.

Heating by Combustion and by Electricity.—Some experiments by Mr. Roberts are briefly described in the Lond. "Elec.," Nov. 2; the same wires were heated first in a flame and then by a current, and it was found that with a platinum wire less than 0.5 per cent. of the thermal energy produced in the flame was transferred to the bar, while 90 per cent. of the electrical energy appeared as heat; in another case an iron bar weighing about 20 lbs. was heated by charcoal and then electrically; in the former case about 0.75 per cent. of the thermal energy was transferred to the bar and in the latter 88 per cent.

Electricity as a Motive Power.—In the conclusion of the discussion of Mr. Selby Bigge's paper in the Lond. "Elec. Eng.," Nov. 2, Mr. Thwaite gives the outlines of a proposed plant for an iron and steel works, in which the economy of coal was essential and in which the coal was to be converted into gas, which was stored and utilized for furnace work and for the generation of electric energy for driving the machinery.

Thermostat.—A new and simple form which is very highly spoken of, made by Naglo, is described and illustrated in the "Elek. Zeit.," Nov. 1. It is based on the difference between the two gases separated by a membrane, the membrane closing a circuit; it is said to be very sensitive and entirely independent of the pressure of the atmosphere; a mere touch of the hand is sufficient to start it with; it is said to be the most reliable and simplest of all those that have been introduced.

Registering Device.—A recently patented device is illustrated and desrcibed in the "Elek. Anz.," Nov. 1, used chiefly for controlling the time when workmen arrive; it operates type by electrical contrivances, the impression from them being taken by hand.

Fatal Charges from Single Leads.—A peculiar case is recorded in "L'Eclairage Elec.," Oct. 20, in which an electrician, Mr. Smillie, noticed that small birds perched on a single wire carrying 20 amperes for charging accumulators, were instantly killed the moment the circuit was closed; this shows that the killing of birds by electric wires is not necessarily due to their flying against them, as is often suppcsed.

Platinum and Its Metals.—A paper on the platinum exhibit at the Antwerp Exhibition, by Mr. Andreoli, is published in "L'Eclairage Elec.,"Oct. 20.

Educational.—A brief synopsis of the course at the Central Laboratory in Paris is given in the Lond. "Elec. Rev.," Nov. 2.

Review of Recent Developments.—In an address by Dr. Van Stephen, published in the Elec. Zeit.," Nov. 1, he gives a brief review of the recent development of the application of electricity.

Paris Exhibition of 1900.—The classification of the group "Electricity", is given in "L'Eclairage Elec.," Oct.20.

Prizes.—A list of prizes offered by a French society, is published in the Lond. "Elec. Rev.,"Oct. 26.

New Books.

THE ELECTRIC CENTRAL STATIONS AT COLOGNE AND AMSTERDAM. By Carl Coerper. Translated from the German by Clarence P. Feldman, New York: The W. J. Johnston Company, Ltd. 32 15"x22" pages of text, 60 illustrations and 33 double page engravings on card board. Price, $25.00.

This magnificent volume, in typography, press work, paper, illustrations and binding, stands unrivalled among engineering publications, and is truly a masterpiece of the art of book-making. With its beautiful head and tail pieces, colored page borders, highly calendered paper, press work, its engravings printed on heavy cardboard and handsome binding, the execution of the book is that of an art publication, and yet there is no sacrifice of the real object of the work as an engineering treatise. The two great central stations which it describes are worthy of the setting given them, for they are acknowledged to be not only the finest on the Continent, but examples of the highest engineering art.

Though the text is limited to 32 pages, when we consider that each of these pages is almost four times the size of that of The Electrical World, it will be understood that they contain by no means an inconsiderable amount of matter. The wood-cuts included in the text are in keeping with the plan of the work in their execution, and enable the details to which they refer to be clearly understood.

The first section of the text is devoted to the Cologne station, and opens with a description, with references to the plates, of the steam plant. The alternators are then taken up and their construction explained and illustrated. The controllers are next considered in considerable detail. This apparatus, from its appearance, is more suggestive of a marine engine room than of a central station, both in the substantial and thoroughly mechanical design displayed and in the use of levers and wheels entirely for operating the parts. The switches, rheostats, etc., are in a room which is locked during the operation of the machinery, and the various devices are manipulated by means of connections to the levers or wheels of the controllers, which are on a platform by a column to which is secured the various meters. By this means there is absolute security from contact with dangerous wires or fittings, as the dynamo connections are carried in closed conduits to the switch room, and there is no electrical connection whatever between the controller levers and their corresponding devices in the switch room. The controller levers also have interlocking devices which prevent them from being moved in any other than the proper sequence.

Each controller has four levers; one, with four positions, successively places the alternator out of circuit, connects it to the load resistance, where it is locked until the necessary resistance is put in, then connects with another alternator in parallel or to the network, and, finally, at the last notch takes out the load resistance. Another lever, for the fields, has three positions; in one position it disconnects the compound exciter and connects a single exciter; the second movement brings up the exciting E. M. F. to 65 volts, and the third couples the compound exciter in parallel to one or all of the working exciters in such a way that the series winding of one exciter carries the armature current of the other, while their terminals send the currents into two collecting rings, this method being one of the features of the Helios system. The two remaining levers are for the regulation of the exciting current. The method of connecting in parallel is explained with reference to a double page engraving, showing the various connections. The final part of this section is devoted to the station wiring arrangements and to the distributing network, and contains illustrations of cut-out stations, connecting boxes, underground house connections, etc.

In the section devoted to the Amsterdam station the steam plant is discussed more in detail. Throughout this section only those parts of the electrical and other equipment are described in detail that are omitted from the Cologne station section or are different in character in some notable detail. The cables are illustrated in full size section in colors, and colored cuts show the manner of insulation and the method of laying the cables underground, which consists of suspending the cable centrally in a wooden trough and then filling in with molten asphalt. Several interesting curves of output are given, one showing the output in one day in the middle of each month from June to December, another from January to June and a third giving the highest load and the receipts and house installations from June, 1892, to December, 1893.

The next section takes up the transformers, meters, motors and other devices. Several instructive curves showing the performance of the transformers are given, and considerable space is devoted to candle-power curves of alternating arc lamps. One of the accompanying tables shows that with a 310 watt, 10 ampere current which, without a reflector, gives a mean spherical candle-power of 550, the light is only reduced to 498 candle-power when a reflector is used. With the reflector, however, all light is thrown below a horizonal plane through the arc. The section concludes with a description of the Coerper induction motor, which is well illustrated, the system of winding being also schematically shown, and a full page plan, in colors, of the primary and secondary works of distribution in Amsterdam.

The two final sections are of particular value, as they give costs, the results of working, and general financial data. A table shows the relation between the number of watts annually spent in magnetizing and the useful output, and other tables give the distribution of light, cost of operation, etc.

The plates, which are all double page cardboard, are beautifully printed, the half-tone process used giving results much superior, as far as we know, to any employed in this country. On maps of Cologne and Amsterdam the distributing net-works are indicated. There are a number of interior and exterior phototype views of the stations and of the machinery, the process used bringing out the details of the latter remarkably clearly. Other plates give plans and elevations of the boiler rooms, engine rooms, etc., a diagram of connections for parallel working, line drawings of machinery, etc.

To the engineer this work will prove of great value, as the plans given are working drawings, while the station manager will find much to interest him in the full details of these fine stations, every minute part of whose design having been the subject of the closest study by throughly trained and competent engineers, and with a view always to the highest economy in working.

ELECTRIC TRANSMISSION OF ENERGY. By Gisbert Kapp. Fourth Edition, New York: D. Van Nostrand Co., 445 pages, 166 illustrations. Price, $3.50.

The fourth edition of Kapp comes like a visit from an old friend. The first edition appeared at the time when there was no art of electrical power transmission and it speaks well for the foresight of the author that so much of his early work can remain to-day comparatively unchanged. The first six chapters dealing with the general principles of dynamos and motors have been but little altered, the most important modifications being in the addition of recent data to the magnetic design of dynamos. The latter half of the book is completely re-written. One of the great difficulties in producing a book upon applied electricity to-day is the choice of an audience. Those who are interested in electrical work differ so widely in attainments, needs, and point of view that in a single treatise it is well nigh impossible to satisfy them all. Mr. Kapp in his present volume appeals directly to the student class and the treatment of the subject is distinctly scholastic. By this I do not wish to be understood as saying that the book is lacking in value to the practical engineer or the investigator, but merely that the treatment is such as to be of the greatest service to the student. In so directing the trend of his work, the author has adopted methods which, while generally popular and often employed, are less general and sometimes more complex than is to be desired. One of the most difficult tasks for a writer on scientific subjects is to strike a happy medium between a direct mathematical discussion of a subject and one based almost entirely on physical considerations. There is even now no satisfactory treatise which stands as a half-way station between the beautifully clear and acute reasoning of Faraday and the splendid mathematical discussion of Maxwell. The course adopted in the present work is perhaps as near middle the way as could well be, but it is necessarily a little too complicated for the general public and less searching than is desired by many students. This fault is, however, perhaps unavoidable. The most important additions to the first editions of the work are the chapters on transmission by alternating currents. Especially to be commended is the chapter on single phase motors, which is the first tolerably simple explanation of the subject which has yet appeared in print. It is necessarily approximate, but opens up to the student a very interesting view of the matter. Here and there it is a trifle misleading, as for example in the stress laid on the necessity for self-induction in such motors. As a matter of fact, the difficulty in building practical single phase motors is to reduce the self-induction sufficiently, and not to maintain it. The necessities of design take care of all possible needs in this particular line. It is rather a pity that the same point of view taken for the single phase motor was not adopted for the discussion of the polyphase systems. The general principles that underlie the action of these two classes of motors are far more similar than is generally supposed. The discussion of polyphase apparatus is, however, on the whole satisfactory. Perhaps a little too much stress is laid on constant current working in polyphase circuits for the method is one that probably will be very little used. The author is particularly happy in pointing out the practical differences and the theoretical similarity between the two-phase and the three-phase systems and the advantages of polyphase motors. It is a little singular, however, that he does not lay more stress on the matter of windings. Most of his results are those obtained from motors with armatures of the squirrel-cage type which are decidedly inferior to and but little simpler than, the short-circuited windings used in American practice, about which Mr. Kapp seems not to have fully informed himself, although his book is well up to date in most other respects. In speaking of the alternator proper, it is interesting to note that the author strongly favors moderate frequencies, from 40 to 65 cycles per second being his choice. His reasoning about the effect of frequency upon the cost of machines is somewhat at fault, however, as he does not point out clearly the fact that with high frequency machines, the unfavorable proportions which often have to be given the field magnets, are a serious disadvanatge. As a matter of fact, it is quite as easy, or easier, to build a low frequency machine for close regulation as a high frequency machine of the same capacity. One must take rather sharp exception to Mr. Kapp's advocacy of considerable self-induction for the armatures of alternators. To be sure, self-induction does act as a safe-guard in case of short circuits, but it is a safeguard which is too expensive and undesirable on account of its effect on the regulation. Some important matters are sadly neglected. It would have been desirable to have given a clear account of the methods used in converting alternating currents, single and polyphase, into continuous currents, as

these are likely to play no small part in the future of the arc, even if the apparatus employed should never be simpler than the rotary converters used in this country. In spite of these faults and omissions, which are perhaps unavoidable in the construction of any handbook of a widely ramifying subject, the present edition of Kapp is by far the best work on the subject which has yet appeared and deserves a place on the table of the student and engineer, to whom it cannot fail to be useful. It is specially valuable as bringing together in connected form a treatment of those modern aspects of power transmission which have been, until now, only treated in the technical journals and even there in such diverse ways as to befog rather than explain the important subjects considered.

QUANTITATIVE CHEMICAL ANALYSIS. By Dr. Alexander Classon. Translated and enlarged by Wm. Hale Herrick. New York: John Wiley & Sons, 220 pages, 56 illustrations. Price, $2.50.

This book is probably the most complete work which has has yet appeared treating upon the subject of quantitative analysis by electrolytic methods. The present addition contains a very considerable quantity of new matter added by the author, and this, with the additions by the translator, brings the book thoroughly up to date. Part I deals, first, with the different means of obtaining and regulating the current; the size and shape of the electrodes, etc. In the section on thermopiles, the translator has given a description of what would appear, from a mechanical and electrical point of view, the best thermopile yet constructed, the invention of a Dr. Paget. It is stated that it is used at the Chicago Refining Works with complete success. Among the batteries described we miss the Edison-Lalande-Chaperon. This, in the writer's experience, is preferable to either the Daniell or storage battery, for the reason that to obtain good results, the voltage on the electrodes must not vary when the apparatus is left to itself overnight with a determination under way, and this desired constancy of voltage is obtained most perfectly with the Lalande cells. The remainder of Part I is taken up with a description of the methods of determining all the principal metals that can be deposited from aqueous solutions, and of the methods of separating one metal from others with which it may be associated. Full details are given as to the best size of electrodes, best current density, and concentration of solutions, data which are only too frequently omitted on accounts of electrolytic methods. Unfortunately, the current is often given in cubic centimetres of detonating gas per minute. This method of measurement should be abandoned, as it is apt to lead to errors, and moreover, necessitates an extra volt for the decomposition. The chapters on the determination of the constitutents of alloys and on the analysis of ores are very complete, and there is a very good appendix containing tables, list of reagents, etc. A considerable number of the processses would be very much shortened, however, if a volt meter were used and the solution first electrolysed at one voltage till all of one constituent was removed, and then the voltage raised until another constituent was removed, and so on. In this method, almost any acid may be used as the solvent and with an automatic voltage regulator and an accurate volt meter and ammeter, a great many different metals can be plated from the one solution, each metal coming over at one definite voltage. There is a wide field here for research, and the investigations of a chemist who attacked the subject of electrolytic separation, armed with these instruments, could hardly fail to result in important developments.

Amongst other things in Part 2, Professor Smith's electrical method of decomposing refractory ores will be welcomed by those who have much work of this kind. On the whole, the book will be found invaluable by all chemists who prefer electrical to purely chemical methods of analysis.

Relative Importance of Electricity in Physics.

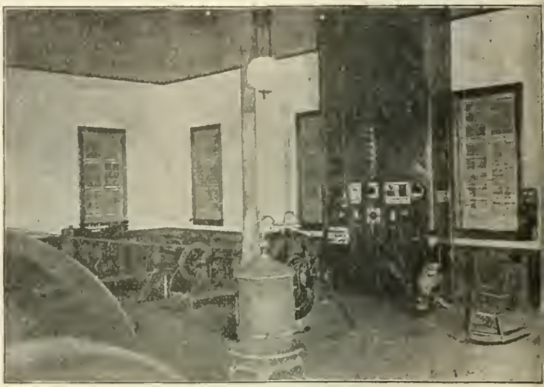
In the last number of the well known physical journal, the *Philosophical Magazine*, six of the seven articles are on electricity, and of these three were contributed from America.

A Western Water Power Plant.

Eighty-eight miles from Chicago on the line of the Michigan Central R. R. at the City of Buchanan, Michigan, is one of the finest water powers in the Western States. The Buchanan Power and Electric Company have, during the past two years, acquired the water rights and necessary land to build a dam across the St. Joseph River, which is able to furnish the company with some 3,000 minimum horse power at low water. During the Summer months the average flow is twelve inches over a dam 400 feet in length.

A power-house has been built on the north side of the river, an interior view of which is shown herewith, where, at the present time, a very finely equipped plant for electric lighting and power is now in daily operation furnishing arc lighting for the streets and stores, alternating current for residences and commercial lighting, and a power circuit for driving the pumps at the city water-works and furnishing current for motors in factories and small shops. The power at present is derived from three turbines of vertical type geared to a line shaft extending from the wheel pits through the entire length of the main dynamo room. The arrangement is such that either or all of the wheels may be used at the same time on the main shaft. Within the dynamo room the shaft is provided with driving pulleys on quills, which are governed by friction clutches.

The present electrical equipment was furnished by the Standard Electric Company of Chicago, and consists of one 60 light Standard arc dynamo, which furnishes current for the street lamps and commercial arc lights; a 4-5kw., 550 volt multipolar power generator, which furnished current for the power circuit to which is attached motors for driving the pumps in the city water-works, as well as various small motors scattered about the towns, also a Standard 1,250 light alternator, 1,100 volts primary, and a full equipment of arc lamps, converters, etc.



BUCHANAN (MICH.) POWER HOUSE.

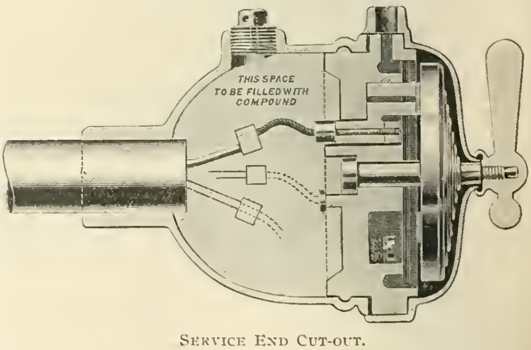
The switchboard is finely equipped with Standard instruments and accessories.

On the opposite side of the river the company is now putting in additional wheels for about 800 horse power capacity, which will be used in the development of power for factory purposes. Some two or three large factories have already been secured which will employ altogether some 200 or 300 hands. Arrangements are being concluded for the location at Buchanan of a number of smaller factories, which will be built at most advantageous points for shipping and use electric motors for power.

A New Service End and Cut-out.

We illustrate a new service end cut-out made by the Interior Conduit and Insulation Company, 44 Broad street, New York, designed to be placed at the inlet of the three-wire system to buildings, and control all the circuits for light and power, the cut-out in case of fire being accessible to firemen. The advantage claimed over a triple break down switch is that it is thoroughly waterproof, an important point since the switch is almost always placed in a location where there is more or less dampness. The piece of pipe enclosing the three conductors is embedded in insulating material and is a standard article of manufacture, as are also the flexible conductors used within the iron case.

In installing, the flexible conductors are first attached to the terminals



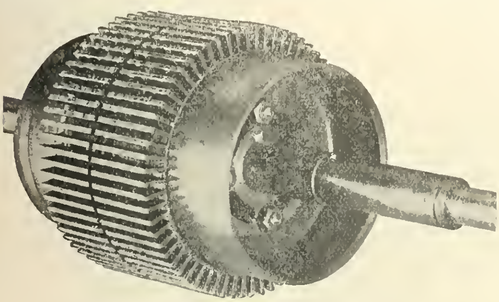
SERVICE END CUT-OUT.

projecting from the conduit; the porcelain base is taken out of the cast iron case, the switch spring disc removed and the wires connected up, using proper fuses, the conduit terminals being carefully soldered to the flexible connector. The porcelain base then is packed with any convenient material, such as sisal rope, the two halves of the iron case put together with their flange bolts, the plug removed at the top of the case and the cavity filled in with insulating compound. The risers are con-

nected through the three inlets provided for that purpose and the mouths packed as they pass through the iron case to insure a tight joint. The cut-out was devised by Mr. E. H. Johnson, president of the Interior Conduit and Insulation Company, in conjunction with Mr. J. H. Van Vleck, electrical engineer of the New York Edison Illuminating Company.

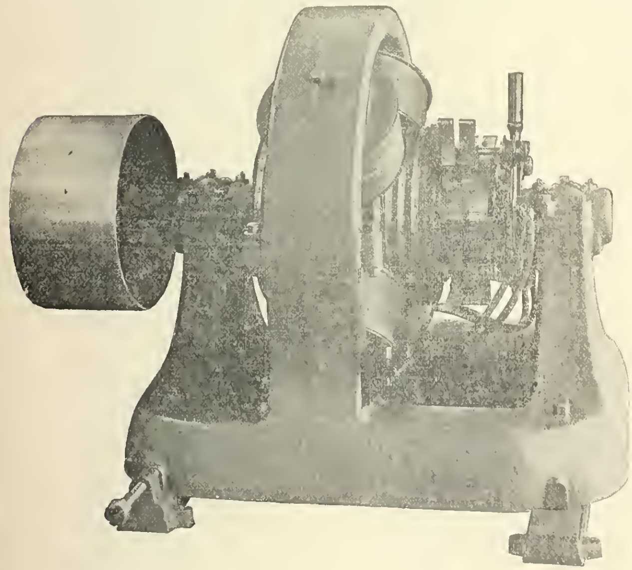
Slow Speed Multipolar Machines.

The General Electric Company has within the past month brought out a new series of slow speed four pole generators and motors which have given excellent results, both under shop test and in commercial operation. The generators, which are built in sizes up to 60-kw, have the magnet circuits shortened, and a greater output and a higher efficiency are obtained from a given weight and speed than from the bipolar type of



ARMATURE OF SLOW SPEED GENERATOR.

generators. The saving of floor space effected by the shape, and slow speed render this type of machine particularly valuable. It is well known that the high speeds common to the bipolar type of machine have



SLOW SPEED FOUR-POLE GENERATOR.

given rise to serious loss of energy in the belts, to expense in maintenance, to noise from belts, to trouble with bearings, to mechanical injury to the armatures and to other objectionable features with which users of this type of machine are familiar. From the slow speed generators under consideration the faults just enumerated are for the most part eliminated. With cheapness in price they combine simplicity in construction, easy accessibility for inspection and repair, and require even under extremely severe usage the minimum of attention.

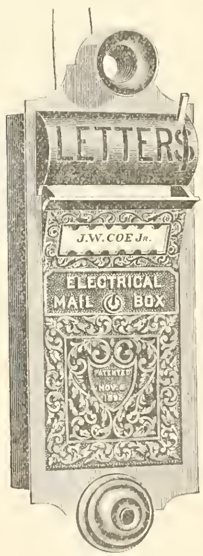
The frame and pole pieces are of cast soft steel of highest magnetic permeability. The armatures are so constructed as to expose the core and windings to constant currents of air, and the copper wire coils are formed and thoroughly insulated before being placed on the core. The insulation is of mica and tough paper and possesses the highest spark resisting qualities as well as great mechanical strength and durability. The design is such that at full load and continuous run the temperature is only slightly elevated. The commutator and brushes work perfectly under all conditions of load and the brush holders give a parallel motion which insures perfect contact with the commutator at all times. The pillow blocks are cast in one piece with the bed plate, and thus it is impossible for the self-aligning and self-oiling bearings to get out of line and the armature off centre. The armature spider is extended and the windings are bound down solid upon it. This gives additional radiating surface and overcomes the difficulty entailed by loose binding wires, while the shape of the spider and the coil allows the ready replacement of an injured coil when necessary. The commutator is pressed upon the shaft and then keyed and the winding section and commutator bars are directly connected. The brush holders are all mounted on a rocker arm and may be shifted simultaneously upon the commutator face. They are so constructed that the brushes will always be presented to the commutator surface at the same angle.

The slow speed motors are similar in appearance to the generators, and by changing the field spools the motor can be changed to a generator for lighting or power purposes and vice versa. All parts are interchangeable. The motors are absolutely sparkless and changes in load from overload to no load may be made without varying the position of the brushes.

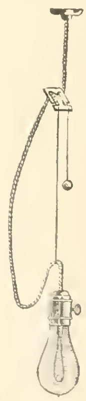
In addition to the above generators and motors, the General Electric Company has designed a line of moderate speed motors and generators to run at a slightly higher speed. They differ from the slow speed type only in the fact that the armature and pulleys and in some cases the field windings are special.

Electrical Mail Box.

We illustrate herewith an electrical mail box invented and patented by J. W. Coe, Jr., of Chicago. It consists of the ordinary mail box, on the top of which is a device by means of which a signal is sent to the occupant of the building when a letter has been placed in the box. The act of opening the box to insert the letter starts a very simple clock motion and the circuit is closed, or rather the commutator turns with the closing of the box. The commutator revolves continuously in one direction so that there is nothing to get out of order. It is understood that the post office authorities favor the device, as it automatically insures the signalling for the delivery of mail and enables the people to



ELECTRIC MAIL-BOX.



LAMP SUPPORT.

distinguish its ring—three short ones—from the ordinary call. It can be placed in the same circuit with the call bell.

Incandescent Lamp Support.

A simple and reliable device for adjusting the height of incandescent lamps, manufactured by E. A. Gay & Company, Beckley Building, 27 South Clinton street, Rochester, N. Y., is shown in the accompanying illustration. The entire device is made of the best insulating material. The balance being a shot-weighted soft rubber ball, it will not break lamps or shades accidentally brought into contact with it. The form of attachment to the lamp cord is such that any size of cord will be securely and positively held without danger of slipping or becoming loose. As the ball is weighted with shot it can easily be adjusted to balance additions to the weight of the lamp. It can be instantly applied or removed without changing the cord or connections in any way.

Financial Intelligence.

The Electrical Stock Market

New York, Nov. 17, 1894.

GENERAL ELECTRIC has been very steady in its quotation. The bull party in the stock is still confident that much higher prices are close at hand, basing their hopes on the continued reports regarding the business the General Electric Company is now doing. So great is the pressure of orders—this is given out as coming from official sources—that the force at Lynn will shortly have to be increased. It is a mistake to suppose, because the pay roll at Schenectady is now double what it is at Lynn, that work had anywhere near ceased in the shops at the latter place. A director offers this piece of information: "Regarding the large order placed with us by Mr. Yerkes, of Chicago, amounting to $500,000, all the indications point to a large increase in this order. Just the extent of this increase it is difficult to estimate; I doubt if Mr. Yerkes can tell what the ultimate amount will be. The outlook for General Electric is excellent. Of course prices are lower than they were a year ago, but business is very good. What worries us now is how to fill orders already on our hooks." This bears out the reports of prosperity current for some time. The indications for a great growth of electric railroad construction next spring offer a lot of promise. Capital has been endeavored to be made out of some litigation announced this week as effecting General Electric one way or the other. Mr. Fish, counsel for the company, says that the decision restraining Bloomingdale Brothers, New York, from using incandescent lamps with carbon filament vacuum is a great victory for General Electric. Regarding the storage batteries litigation, Mr. Fish says: "I am confident the court will sustain the suit of the Brush Company against the chloride battery people (the Elec-Storage Battery Company, of Philadelphia). The testimony has not yet been taken, however, and decision will probably not be rendered for a year or more."

WESTINGHOUSE ELECTRIC issues are a little more active. The story now is that the next dividend on Westinghouse Electric preffered stock will be paid in scrip instead of cash. This is as yet only gossip, but it may have a foundation in fact, as the company has been spending a lot of money on the new plant. A very considerable portion of the Westinghouse Electric Company's plant has already been removed to the new buildings at Brinton, Pa., and the work of changing is progressing at a rate that will make the entire removal complete by January next. The business of the company continues good. For October it aggregated about $500,000, most of it in small contracts. Earnings continue large, and all shops are running to their full capacity on orders taken on a basis equivalent to cash, and secured in sharpest competition with the field. Low prices for electrical equipment continue to rule, but the company, nevertheless, is understood to be making a satisfactory profit. As one of the Westinghouse Company's friends puts it. "Few, if any, manufacturing concerns of equal magnitude could make a better showing on business done and business in sight than the Westinghouse Electric and Manufacturing Company."

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101	102
" " " Brooklyn	100	109	112
" " " Boston	100	125	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	35	35½
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	35	36
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	1,000	107¼	107¾
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	91
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	195	197
American District Telegraph	100	40	45
American Telegraph & Cable	100	88	91
Central & South American Telegraph	100	102	105
Commercial Cables	100	125	145
Erie Telephone	100	52	54
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
*New England Telephone	100	67	69
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	88	88½

* Ex-div.

AMERICAN BELL TELEPHONE stockholders have voted to authorize the president to request the Commissioner of Corporations of Massachusetts to take action under the act of the Legislature and fix the market price for an offer of 5,000 shares of additional capital stock to the shareholders. This issue is in the nature of an experiment and upon its outcome depends the increase of the capital stock from the present $20,000,000 to the $50,000,000 authorized by the Legislature under certain restrictions. The $30,000,000 new stock is required for extensions of long distance lines to the West, Northwest and South, and in developing sub-company exchanges, etc. Pending the result of the "experiment," very little trading is being done in the stock.

ELECTRIC STORAGE BATTERY stock slumped this week 9¼ points to 20, on the adverse result of litigation in New York, but it recovered somewhat afterward on the statement by President Robert W. Gibbs that the decision is not final and only delays work until May next, when the patent on which the suit has been brought expires. "The result of the decision," says Mr. Gibbs, "does not affect the value of the company to any extent, and will not in any respect interfere with its operations."

EDISON ELECTRIC ILLUMINATING, of New York, according to figures furnished by Treasurer Williams, continues to forge ahead. Gross earnings in October were $122,723, a gain of $18,275 over October, 1893, while net earnings show a gain of $4,273, the total being $60,527. For the ten months ending October 31, gross earnings were $1,090,112, an increase of $133,444 over a similar period in 1893, and net earnings were $563,491, a gain of $122,367.

EDISON ILLUMINATING, OF BROOKLYN makes equally as good a showing. Gross earnings for October were $42,239, a gain of $12,259, and net earnings were $20,453, a gain of $5,654. Net income was $21,767, an increase of $5,518. Interest on bonds calls for $2,100, so that there is left applicable for dividends $19,667, an increase of $5,518, or over 40 per cent.

WESTERN UNION TELEGRAPH has fluctuated somewhat, but not much. The bull pool seems to be reducing its holdings to a moderate extent, and manipulators have generally been sellers of the stock.

THE STREET RAILWAY & ILLUMINATING PROPERTIES have further set aside $60,000 to buy in preferred stock; bids will be received till November 21.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY, the Bell Company's rival on Long Island, has just had $910,000 of its general mortgage 5 per cent. bonds listed on the Stock Exchange.

ELECTRIC TRACTION STOCKS, a class of securities that lately have found a deal of favor, especially among investors, by reason of the great possibilities of increasing earnings and the assurance of security attaching to the companies they represent, are day by day attracting a larger share of Wall street's attention. But one or two are actually listed on the Stock Exchange, but a goodly lot of transactions occur on the outside. In Philadelphia, Baltimore, Chicago and Boston, however, an ever-increasing business is being done in these securities on the local exchanges, Philadelphia trading being often times given over entirely to traction stocks. The local market has been rather quiet this week, but the following table gives some indication as to what is being done in the stocks traded in in New York:

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	140	150
Brooklyn Traction pfd.	65	68
" " common	13½	15
Long Island Traction	12½	13
Rochester St. Ry	29½	30½
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	56	58
North Shore Traction	22½	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	108	109
Philadelphia Traction	104	104½
People's Traction	54	54½

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. m. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	—	90

*With accrued interest.

New Incorporations.

THE PEOPLES' ELECTRIC LIGHT COMPANY, Valparaiso, Ind., capital stock $30,000, has been formed.

THE TURNBULL ELECTRIC LAMP COMPANY, New Orleans, La., capital stock $300,000, has been formed.

THE PHOENIX NATIONAL TELEPHONE COMPANY, Indianapolis, Ind., capital stock $100,000, has been incorporated by Marlin Caldwell, John W. Parrish and Jacob Frankel.

THE MUNCIE ELECTRICAL WORKS, Muncie, Ind., capital stock $25,000, has been organized to manufacture and sell electrical and other machinery. Webster S. Richey, Albert S. Richey and Richard F. Platt are interested.

THE JASPER COUNTY ELECTRIC RAILROAD COMPANY, Carthage, Mo., capital stock $150,000, has been formed to construct a railroad. The promoters are J. W. Halliburton, F. W. Fitch and Isaac Perkins, all of Carthage, Mo.

THE MT. JEWETT ÉLECTRIC LIGHT AND POWER COMPANY, Mt. Jewett, Pa., capital stock $2,000, has been incorporated to supply light, heat and power. M. J. Gallup, A. G. Phillips and C. J. Stahl, all of Mt. Jewett, are interested.

THE EQUIPMENT CONSTRUCTION COMPANY, Albany, N. Y., capital stock $10,000, has been incorporated by Montgomery R. Johnson, Thomas P. Nightingale, Utica; Lena Beecher, Chas. A. Seaver and Jos. W. Holmes, Batavia, N. Y.

THE CAMBRIDGE ELECTRIC LIGHT AND POWER COMPANY, Cambridge, Ill., capital stock $12,000, has been formed to erect an electric light plant. The organizers are D. D. Lamb, Henry White, C. M. Turner, E. D. Richardson and F. O. Dahlberg.

THE BELVIDERE TELEPHONE COMPANY, Belvidere, Ill., capital stock $6,000, has been formed to furnish telephone and electric service and electrical supplies. W. M. Mareau, Omar H. Wright, Jr., John G. Tripp and J. R. Balliet, are interested.

THE PERU ELECTRIC LIGHT AND POWER COMPANY, Peru, Ind., capital stock $60,000, has been formed. Volney Q. Irwin, Crawfordsville, Ind.; Paul E. Covington, Kansas City, Mo., and Nat. Covington, Peru, Ind., are among the incorporators.

THE MADISON ELECTRIC LIGHT & POWER COMPANY, Madison, Neb., capital stock $10,000, has been formed to construct and operate an electric light and power plant in Madison. The promoters are Wm. V. Allen, Peter Rubendall and Frank P. Prince.

THE ATLANTIC & PACIFIC IMPROVEMENT COMPANY, Tacoma, Wash., capital stock $400,000, has been formed to buy and sell personal property and real estate, build and operate electric railways, etc. Charles B. Mortice and John R. Mortice are the promoters.

THE FLORENCE POWER AND WATER COMPANY, Florence, Col., capital stock $100,000, has been organized to supply electric and steam power for mills, also a system of water works, etc. W. E. Johnson, W. K. Johnson and H. A. Sumner, all of Florence, are iuterested.

THE BOSTON & SEQUIM COAL COMPANY, Port Townsend, Wash., capital stock $50,000, has been formed to operate electric plants, railroads, mines, etc. Wm. B. Dennis, Wm. A. Halteman, N. C. Strong, H. H. Boyce, D. C. Heath, A. B. Poland and Graham D. Dennis are interested.

THE ELECTRICAL MAINTENANCE COMPANY, New York, maximum capital stock $250,000, has been formed to contract with owners of dynamos, electrical plants, etc., to keep same in good repair, etc. John Dau, Freman D. Bewley, and R. L. Johnson, New York City, are interested parties

THE MECHANICSVILLE AND BOILING SPRINGS ELECTRIC RAILWAY COMPANY, Harrisburg, Pa., capital stock $100,000, has been incorporated to construct, maintain and operate an electric railway. John B. Skyles, Martinsburg, S. Ritter Ickes and W. K. Meyers, Harrisburg, Pa., are the promoters.

THE F. P. ELECTRIC COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated by Edward J. Frost, Charles W. McCorkle and E. W. Cramer.

THE MICHIGAN LIGHTING COMPANY, West Bay City, Mich., capital stock $10,000, has been incorporated by Frank Mohr, George Standacher and Edward McGinnis.

THE NORRISTOWN AND PERKIOMEN CREEK ELECTRIC RAILWAY COMPANY, Philadelphia, Pa., capital stock $50,000, has been formed to conduct, maintain and operate an electric railway. P. W. Smith, Drexel Building, Philadelphia: Harvey R. Parsons and James J. Reban, of Philadelphia, are the promoters.

THE BOYNTON TRANSIT COMPANY OF SPAIN, New York, maximum capital stock $5,000,000, has been formed to acquire patents for appliances relating to steam and electrical railways, etc. J. F. De Navarro, New York; Eben Moody Boynton, Newbury, Mass., and Wm. H. Boynton, New York, are intrested parties.

THE CENTURY TELEPHONE COMPANY, New York, maximum capital stock $250,000, has been formed to manufacture and use all kinds cf electrical machines, etc., construct, equip and operate telegraph and teleph ne lines, etc. Henry O. Reed, E. F. Birdsall, New York, and G. H. L. Morton, Dobbs Ferry, N. J., are the promoters.

THE MOUNT VERNON AND WALHONDING ELECTRIC RAILWAY COMPANY, Mount Vernon, O., capital stock 50,000, has been formed to build and operate an electric railway, or to operate by other motive power between Mt. Vernon and Walhonding. Fred. T. Botzum, W. F. Bullinger, Harry C. Devin, and others are interested.

THE BOYNTON TRANSIT COMPANY OF FRANCE, New York, maximum capital stock $5,000,000, has been incorporated to acquire patents and patent rights for appliances, etc., relating to electric and steam railways, etc., in France. The organizers are J. F. DeNavarro, New York; Eben Moody, Newbury, Mass., and Wm. H. Boynton, New York.

THE KIDDER ELEVATOR INTERLOCK COMPANY, New York, maximum capital stock $300,000, has been formed to manufacture and sell electrical, mechanical, pneumatic appliances, etc., for use on passenger, freight and other elevators. W. P. Kidder, Boston, Mass.; Clement B. Smith, Wilmington, Del., and H. S. Stallknecht, New York, are the organizers.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, Nov. 17, 1894.

THE COMMITTEE ON GAS AND ELECTRICITY of the Brooklyn Board of Aldermen reported in favor of granting a franchise to the Municipal Electric Light Company for the part of the city not covered by its existing grant.

COMMISSIONER WHITE, of Brooklyn, has been asked for authority to prepare specifications and advertise for proposals for gas and electric lighting of the streets and public buildings during 1895. The existing contracts expire December 31st.

THE ELECTRIC HEAT ALARM COMPANY, West First street, South Boston, has opened an office in New York at 1139 Broadway, Room 5, with Mr. Chas. Lyman, formerly in charge of Mills building, as manager. Among other apparatus are some excellent devices for marine work which are well worth inspecting.

THE ALDERMANIC COMMITTEE ON GAS & ELECTRICITY of Brooklyn, N. Y., will report in favor of granting a franchise to the Municipal Electric Light Company to extend its plant, now confined to the Eastern District, into the Western District wards. The company is to pay the city $20,000 in cash for the privilege, furnish arc lights to the city for 40 cents apiece per night and put all wires underground.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, November 17, 1894.

MR. F. E. PETTINGELL is no longer identified with the Thompson-Brown Electric Company, of Boston, having tendered his resignation and the same has been accepted.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has removed its New England office from 620 Atlantic avenue to Exchange Building, 53 State street, Boston, where it is located on the third floor, its quarters embracing five commodious rooms.

CAPT. WILLIAM McGREGOR, formerly collector and treasurer of the Pawtucket (R. I.) Gas & Electric Light Company, and connected for 10 years with the company, has by a unanimous vote of the Board of Directors been appointed superintendent of the entire business of the company, to succeed the late Mr. Samuel G. Stiness—a recognition well deserved by a faithful discharge of duty.

MR. ALTON D. ADAMS, electrical engineer, 620 Atlantic avenue, Boston, Mass., has undertaken the repair of electrical machinery with facilities second to none in the country, for the heaviest class of work. The equipment is all on the ground floor, and machines are unloaded from cars by cranes directly into the shop. A specialty will be made of heavy central station repairs and the largest machines now in use can be readily handled. Mr. Adams' experience and success in the design of electrical machinery indicate that work intrusted to him will be carried out in the best manner.

THE COLBURN ELECTRIC MANUFACTURING COMPANY, of Fitchburg, Mass., has decided to locate in a home of its own, and with that end in view will at once commence the construction of a handsome two-story building of 40 feet frontage and 155 feet depth, the arrangements and appointments of which will embrace all possible facilities and accommodations for the manufacture of its dynamos, motors and other electrical apparatus which are so well known as to require no special mention. The new building will be on Winter street, right near the depot and very near the spot on Boutelle street where Mr. Colburn started in the electrical business in 1881.

MR. R. O. Hood, for the past three years connected with the General Electric and T.-H. Companies as meter expert and in charge of the New England meter business, has severed his connection with the company and opened an office at 15 Federal street, Boston, where he will represent the Wagner Electric Manufacturing Company and Columbia Incandescent Lamp Company, of St. Louis, Mo. The Wagner Company, as is well known, are making a specialty of high grade transformers of high efficiency and remarkably small leakage current. Mr. Hood is well known among all station men in the New England states, and owing to this extenive acquaintance, his business abilities, and the character of the goods he will handle, we have reason to believe that he will be successful in his new enterprise.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago,
November 17, 1894.

F. W. DAVIS, Secretary of the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., was a recent visistor to Chicago.

THE HARRISON INTERNATIONAL TELEPHONE COMPANY report sixty-one exchanges under construction, and eighty-five already in operation. In the telephone business at least affairs are brisk.

THE METROPOLITAN ELECTRIC COMPANY is a busy firm just now. Anticipating a large fall trade (which came all right), it has a sufficient stock of specialties to fill all orders. It has made arrangements to handle the Allen Soldering Sticks and has a large stock on hand.

THE HORNBERGER ELECTRIC MANUFACTURING COMPANY, of Elkhart, Ind., have issued a very handsome little pamphlet descriptive of the Elkhart transformer. This is well filled with flattering testimonials, and the new president of the company, Mr. James F. Boss, who was a Chicago visitor during the week, reports business flourishing.

News of the Week.

Telegraph and Telephone.

SHEBOYGAN, MICH., has passed an ordinance giving F. S. Dewey, of Alpena, a franchise to erect a telephone exchange.

LYNCHBURG, VA.—A new telephone company has been organized. The president is W. P. Roberts; vice-president, Edgar Franklin; secretary and treasurer, Walker Pettyjohn; directors, James Hancock, C. W. Scott, R. J. Snead, W. L. Pierce, H. P. Woods. They expect to have a line in operation by January 1st.

BOSTON, MASS.—The American Bell Telephone Company has voted to accept the act passed by the General Court of Massachusetts authorizing it to increase its capital stock. It was decided that the amount of the capital stock of the company be increased from $20,000,000 to $25,000,000, and the number of shares from 200,000 to 250,000, each of a par value of $100.

WASHINGTON, D. C.—An interesting situation in regard to telephones for the government is developing in the departments in this city. The question to be decided is one directly affecting the general use of instruments for governmental purposes. The varous departments require interconnection and also some economical means of internal communication. It is claimed that the rates of the telephone company, the licensee of the Bell Company, operated in Washington, and the well-known fact that it will only rent and not sell apparatus, have so far prevented the adoption of a system in all the departments that would largely dispense with messengers and act as a decided lubricant to the ponderous wheels of routine. The Interior Department has taken the initiative, and it will soon be settled whether or not a reliable telephone system can be owned and operated outside of the Bell privilege. Bids were received and opened a month ago, but were all rejected on account of technicalities. Hon. William H. Sims, Acting Secretary of the Interior, on November 15 extended invitations to manufacturers of telephones to enter bids for the construction of a system connecting the Interior Department and all its bureaus before next spring. If this is successful, it is probable that the Government will adopt the telephone largely as a valuable aid to business in all its branches. The proposals above referred to are to be opened at the Department of the Interior at 3 o'clock on Tuesday, December 18, 1894. Specifications will be furnished on application.

Electric Light and Power.

PALMYRA, N. Y.—The village of Palmyra is agitating the electric light question.

ONEONTA, N. Y.—There is talk of changing the street car system in Oneonta to an electric road.

NEW ORLEANS, LA.—The New Orleans Traction Company will build an electric power plant to cost about $500,000.

FREDERICKTOWN, MO.—The proposition to light the streets of Fredericktown with electricity was carried at a special election.

LISBON, IOWA.—The firm of Adams, Green & Company, of Morrison, has obtained the contract to put in an electric light plant.

BOSTON, MASS.—The Holmes Electric Protective Company's plant was recently damaged by fire, and the estimated loss is $5,000.

WAPAKONETA, O.—Electric lighting proposition was defeatded at the election. Private parties will put in an incandescent lighting plant.

SEA ISLE CITY, N. Y.—Sea Isle City Electric Light Company has decided to substitute arc lights for the incandescent lights now in use on the streets.

WILKINSBURG, PA.—The Wilkinsburg Council has appointed a committee to investigate the feasibility of the city securing its own electric light plant.

THE CONEY ISLAND AND BROOKLYN RAILWAY COMPANY has petitioned for permission to extend its tracks through High street, from Jay to Washington street.

NORTH BRANCH, MICH.—North Branch will probably have electric lights soon, Rochester parties having offered to put in a plant in the village for a bonus of $400.

MANCHESTER, N. H.—The John B. Varic Company has asked permission to erect a power-house on the Bridge street extension. The request was granted on motion of Alderman Maxwell.

LE ROY, N. Y.—The Le Roy Hydraulic Electric Company was granted permission to string wires and erect poles for transmitting electricity for light on streets where there are no poles.

EAST ORANGE, N. J.—The people of East Orange are now discussing the matter of an electric light plant. It is estimated that for a sum of $50,000 a plant can be put in running order.

FLEMINGTON, N. J.—A meeting was held to obtain the opinon of the citizens regarding the lighting of the streets by electricity. The question was put to a vote and unanimously adopted.

SPRINGFIELD, ILL.—The Capitol City Electric Light Company, recently organized, is considering proposals for location of its plant, and also for machinery for the same. The plant will cost $100,000.

PORTLAND, ME.—A fire in the electric light works caused damage of less than $1,000 to the building, but all the valuable machinery was deluged with water, so that the loss will be $50,000, and perhaps more.

BUFFALO, N. Y.—Before the new year the American Structural Steel Company, of Pittsburg, will begin the building of a Bessemer steel plant, to cost $900,000. The company, it is said, will use electric power.

SAGINAW, MICH.—The Board of Water Commissioners on November 14 instructed the secretary to ascertain the cost of plants and feasibility of lighting two pumping stations with electricity. F. D. Keeler is secretary.

CLEVELAND, O.—County Auditor Schellentrager favors the erection of a complete electric lighting plant in the court-house, and the removal of the gas fixtures. There is plenty of power in the present engine-room to run the dynamos.

WEEDSPORT, N. Y.—Application has been made to the Board of Trustees of the village for an electric light franchise. The applicant is The Weedsport Spring Wire Truss Company. It is understood that the franchise has been granted.

HAMILTON, O.—At the meeting of the City Council, the contract for the Hamilton electric light plant was awarded to the Western Electric Light Company, of Chicago, at its bid of $30,080. It was for electric dynamos and line constuction only.

HADDONFIELD, PA.—At a meeting of the Borough Commissioners an ordinaance was passed giving the Haddonfield Light & Power Company the exclusive right to erect poles and string wires on the streets of the borough for a period of five years.

ROCHESTER, N. Y.—At a meeting of the Board of Trustees of the village of Waterloo, Trustee William L. Sweet reported that the officers of the Geneva & Waterloo Electric Railway had communicated with him, asking for a conference in regard to obtaining permission to build the road down through Main street.

NEW HAVEN, CONN.—The New England Public Works Company has been organized at New Haven with a capital of $25,000, to take contracts and to operate water works, electric light plants, etc. The subscribers are Edward H. Phipps and Wm. S. Pardee, New Haven; Chas. H. Eglee, Flushing, N. Y., and others.

MILLVILLE, PA.—A meeting of Common Council was held, to consider the new contract with the Millvile Electric Company for lighting the city. The contract expired November 1st. After somewhat lengthy discussion it was decided not to accept the figures, and the Light Committee was instructed to advertise for proposals.

CAMBRIDGE (BOSTON), MASS.—The joint special committee on municipal lighting of the Cambridge City Council held a meeting to consider the opinions requested of the city solicitor relative to the establishment of municipal lighting plants. The committee voted to accept the city solicitor's recommendations and report accordingly to the City Council.

BOSTON, MASS.—The Boston Electric Light Company has presented a petition to the Gas and Electric Light Commission, asking for an issue of $900,000 additional bonds. The company claims that the law compelling it to put its wires under ground has put it to a great expense, and this is one of the reasons assigned for the issue petitioned for.

The Electric Railway.

MIDDLETOWN, CONN.—Mayor Vinal has granted permission to the contractors to work the men on the electric road.

PELHAM MANOR, N. Y.—Pelham Manor residents are anxious for the extension of the trolley road to their village.

LANGHORNE, PA.—Work on the Hulmeville, Langhorne and Bristol trolley [illegible] will begin early next month at Langhorne.

READING, PA.—The Board of Trade recommends that the Council borrow $400,000 to put in a municipal gas and electric light plant.

CLARKSBURG, W. VA.—The Clarksburg & Suburban Street Railway Company has been incorporated to construct a street railway.

CAMDEN, PA.—The Camden Horse Railroad Company is placing trolley lines on Delaware avenue between Federal and Market streets.

BROWNSVILLE, N. Y.—The Street Railway Company is engaged in selecting a route for the proposed continuation of its line to Dexter.

HAMILTON, N. Y.—The Hamilton Electric Radial Railroad Company has prepared plans for roads spreading out from Hamilton in all directions.

BALTIMORE, MD.—If present plans are carried out Baltimore will be connected with Washington and Gettysburg by electric railways.

OSWEGO, N. Y.—C. B. Price purchased the Oswego Street Railroad, and said that a franchise will be asked for the extension of its tracks.

PROVIDENCE, R. I.—The Manville Mills, at Manville, will be lighted by electricity. The main office of the Mauville Company is at Providence.

OTTAWA, CANADA.—One hundred thousand dollars are to be asked from this city as a bonus for the proposed Ottawa & Brockville Electric Railway.

IRONTON, O.—F. E. Holliday is at the head of the proposed Pomeroy & Middleport (O.) Street Railway, and in the market for second hand material.

CAMDEN, N. J.—The West Jersey Traction Company has asked permission to construct, maintain and operate a street railroad through certain streets of the city.

PORTLAND, ORE.—The plant that furnished the electric light at the Willamette Steam Mill, Lumbering & Manufacturing Company was destroyed by fire.

HARLEYSVILLE, PA.—Philadelphia capitalists have made applicaton for a charter for a trolley line from Spring House to East Greenville. The line is assured.

ST. LOUIS, MO.—The Citizens' Railway Company, Robert McCulloch, general manager, will soon be equipped with electricity. Ten miles of the road are operated by cable.

MANCHESTER, N. H.—A resolution has been introduced into the City Government allowing the Manchester Street Railway to erect wooden posts on Elm street for an electric road.

COLLINSVILLE, CANADA.—There is much oppositon here to the extension of the electric road from Unionville to this place. The selectmen do not favor the use of the highways for the purpose.

ANAHEIM, CAL.—Sealed bids will be received by M. Nebelung, clerk of the City of Anaheim, November 27th, for the construction of an electric light plant, as per plans and secifications on file in his office.

NORWICH, CONN.—The owners of property and those residing near the foot of Whittaker Hill have presented a petition to the Street Railway Company asking it to extend the tracks to the foot of Whittaker Hill.

PEEKSKILL, N. Y.—The Board of Trustees of the village will meet to give an opportunity for the citizens to be heard regarding the granting of a franchise to one of the trolley electric railway companies applying for it.

COLUMBUS, GA.—The Drake & Stratton Company, which has the contract for reconstructing the Columbus Railroad for its equipment with electricity, have commenced work. J. F. Flournay is president of the road.

NEW BRIGHTON, S. I., N. Y.—The Midland Railway officials presented a petition to the New Brighton Trustees asking for permission to change their motive power to electricity. The petition was referred to a committee.

SOUTH ORANGE, N. J.—The Newark and South Orange Railway Company has asked for consent and location of tracks or route in the township of South Orange. Elias S. Ward is president and Jos. H. Osborn, Township Clerk.

TOWER CITY, PA.—A movement has been commenced for the construction of an electric railway through the Williams Valley, commencing here and extending through Williamstown and Lykins. Right-of-way has been granted.

SOUTH ORANGE, N. J.—The South Orange & Maplewood Railway Company has asked for consent and location of the tracks or routes in the Township of South Orange. Frank Brewer is president and Jos. H. Osburn, Township Clerk.

WAVERLY, N. Y.—A project is on foot to connect Waverly and Elmira by an electric line, the tracks to follow the river road from the latter place and join the Elmira and Horseheads line with the Waverly, Sayre and Athens road.

READING, PA.—The Lititz Record says several gentlemen from Reading were in Lititz last week consulting with people about the building of an electric railroad from Manheim to Reading, the line to pass through Rothsville, Akron and Ephrata.

ST. LOUIS, MO.—Application will be made to the City Council for a franchise for an electric railway by the St. Louis & Southwestern Street Railway Company. George C. Fox is president of the company, A. E. Weiss, vice-president, and J. M. Wiener, treasurer.

WINTON PLACE, O.—Sealed proposals will be received until the 20th of Novemebr, 1894, for the construction and operation of street railroad route No. I. Bids must be sealed and addressed to the Village Council of the Village of Winton Place, in care of R. B. Poage, Village Clerk.

BALTIMORE, MD.—Stockholders in the Clifton Passenger Railway Company have decided to take active steps towards the construction of the road, and to organize in December. The capital is $50,000, and the road is to be an electric one from Clifton Park to some point on North avenue.

COLUMBIA, PA.—Col. G. W. Bratton, of Philadelphia, and C. E. Hennessy, of Columbia, appeared before the council with an ordinance asking for the right of way through the borough for the line of the Columbia, Ironville and Mount Joy Traction Company. The matter will be considered.

RICHMOND, VA.—The special committe appointed by council met. The City Engineer and City Attorney will be requested to submit at the next meeting a statement as to the provisions of the charter in question and the relation of the Richmond Railway & Electric Light Company to the city.

BALTIMORE, MD.—The United States Circuit Court has decided that the Lake Roland Elevated Railway Company has the right to lay a double track on Lexington street, between North and Charles street. President James L. McLane, of Lake Roland Company, can probably give information.

FAIRHAVEN, MASS.—The hearing given by the Fairhaven selectmen to E. S. Brown and Lot B. Bates, a committe on the part of the Union Street Railway

Company, in relation to arranging terms for equipping the road in Fairhaven with electricity, was held in the town hall, Fairhaven. Nothing definite was arrived at.

SCHUYLKILL HAVEN, PA.—The Town Council of the borough of Schuylkill Haven adopted an ordinance giving the Pottsville & Reading Electric Railway Company a right-of-way over the streets of that corporation. Charles Barrett, president of the Schuylkill Electric Railway Company, and William Wilhelm, attorney for the former company, were the only representatives present.

PHILIPSBURG, PA.—Sealed proposals will be received by the Clearfield Traction Company, of Philipsburg, until December 4, for furnishing all material and erecting a boiler house, engine house, car barn, and office building at Philipsburg, Center County, Pa. Specifications may be obtained and plans examined upon application to either John G. Platt, or to E. W. Hess, engineer, Philipsburg, Center County, Pa.

BALTIMORE, MD.—The Washington & Baltimore Electric Railroad will, it is said, be built this fall, and work will be immediately commenced. The entire road from Washington to Baltimore has been surveyed and the section between Laurel and Washington will be built first. Two power-houses for the generation of electricity will be located, one at Laurel and the other somewhere near Washington. David M. Newbold is president.

SAN FRANCISCO, CAL.—E. P. Vining, formerly traffic manager of the Union Pacific Railroad, and arbitrator of the Western Passenger Association, is to take full charge of the street car lines in this city, owned and controlled by the Southern Pacific Company. Mr. Vining, who will receive $15,000 a year, will displace M. D. Stein, who has been general manager of the company since the consolidation of the various lines.

UNION, N. Y.—The projectors of the Binghamton, Lestershire and Union Railroad Company have applied to the trustees of the village of Union for the right of way through Main street in that village. The matter will be considered at a special meeting of the trustees to be held in Union, November 26th. Superintendent J. P. E. Clark of the Binghamton Street Railway Company, said that work on the road to Union will surely be commenced early in the spring.

HAMILTON, ONT.—Application will be made at the next session of the Ontario Legislature for the incorporation of the Toronto, Hamilton and Niagara Falls Electic Railway Company, with power to construct an electric line railway from the city of Hamilton to the Niagara River at or near Niagara Falls, and also a branch line from the village of Grimsby south through or near Dunnville. The application is being made by the same firm of solicitors as acted for the Lake Erie Acqueduct Company.

NEWTON, MASS.—A hearing has been granted to the Newton & Boston Street Railway Company on its petition for a location on the Commonwealth avenue boulevard, and on such streets as may meet the approval of the citizens of Newton Centre for a connecting line between the boulevard and the village. The Newtonville & Watertown Company will petition for a location on Watertown street, from Walnut street, Newtonville to the Wellesley line, and on Walnut street to connect with the tracks of the Newton & Boston road.

MISCELLANEOUS NOTES

A CORRECTION.—The suit against Mr. Westinghouse mentioned in our last issue, is brought by Mr. R. S. Waring, Jr., and not by the Standard Underground Cable Company as inadvertently stated in that item. Mr. Westinghouse is the president of the Standard Underground Cable Company. Mr. Waring was formerly connected with that company, but has not been so connected for about two years.

MR. HENRY H. WIEGAND will give a course of night lectures at Baltimore on the principals and practice of electricity, which will be adapted to the wants of those whose business brings them daily in contact with the practical applications of that science. The instruction will be in the form of lectures entirely, and free from abstruse mathematical calculations. The lectures will be illustrated by experiments, for which purpose ample apparatus has been provided.

THE WESTERN SOCIETY OF ENGINEERS on its November excursion visited the industrial works of South Chicago, including the following plants: Illinois Steel Company, Iroquois Furnace Company, Chicago Ship Building Company, and Morden Frog and Crossing Company. A special train, by the courtesy of the Baltimore & Ohio Railroad, was placed at the service of the society for the day. The policy of having such monthly object meetings seems to be a very wise one, and has also met with much success in the East, in the case of the New York Electrical Society.

THE ASSOCIATION OF PRACTICAL ELECTRICIANS OF CHICAGO, incorporated in April, 1894, and promises to have a successful career. The objects of the Association are the education and the advancement of the men engaged in electrical work, to a better knowledge of the science and practice of proper electrical installation and construction. Among the features is a corps of instructors elected at the annual meetings who shall give instruction in the respective branches for which they have been named, and a progressive series of examinations. The officers of the Association are: Geo. E. Sanford, president; G. H. Jacob, vice-president; J. L. Hagadorn, recording secretary, and G. H. Farrar, financial secretary.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its 91st meeting at 12 West 31st street, New York City, on Wednesday, November 21st at 8 P. M. A paper will be presented by Prof. George D. Shepardson, University of Minnesota, Minneapolis, entitled "Suggestions for an Index of Engineering Literature." An opportunity will also be offered for the discussion of the paper read by title at Philadelphia, by Mr. Charles P. Steinmetz, of Schenectady, and Dr. Frederick Bedell, of Ithaca, on "Reactance, and Its Definition." A meeting of Western members will be held on the same evening at Armour Institute, 33rd street and Armour Avenue, Chicago. The secretary announces that the office of the Institute has been removed to rooms 1009 and 1010 Havemeyer Building, 26 Cortlandt street (10th floor), New York City, the change having been decided upon by Council after careful consideration during the past three months by a committee. The Institute meetings will be held at 12 West 31st street as heretofore, until further notice. The office will be open from 9 A. M. to 5 P. M., and is equipped with a long distance telephone, and district messenger service. Over 100 electrical, mechanical and engineering periodicals will be found on file. Members visiting this city will find the rooms as convenient for their accommodation as were those at the World's Fair.

Trade and Industrial Notes.

THE SLOSS-STEIN ELECTRIC COMPANY, Chicago, Ill., has certified to an increase of capital stock from $50,000 to $100,000.

THE LOUIS K. COMSTOCK COMPANY, electrical engineers and contractors Monadnock Block, Chicago, have recently opened an office in Detroit, Mich., in the Hodges Building.

THE INTERNATIONAL ELECTRICAL SUPPLY COMPANY, Detroit, Mich., is introducing a lock nut particularly adapted for street railway use. It consists of a right and left threaded bolt and nut keyed together and is specially adapted for use where there is much vibration.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., reports having made some heavy shipments of transformers during the past week. This company is meeting with much success with its transformers, whose claims have been upheld by the results of actual use during a period long enough to judge.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is making a special effort at present with C. E. M. jack-knife and motor switches. The C. E. M. Switch is one of the first jack-knife switches on the market having the spring catch to hold the jaw open or closed and give it a quick and positive action.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has contracted for the general western agency of the well known line of switches manufactured by the W. S. Hill Company, and has also the control in the West of the Kinsman desk lamp. The Central Electric Company will carry a complete line of these goods in its Chicago warerooms.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., has entered an order from Messrs. Cramp & Sons, for the equipment of the American liner "St. Louis" with the Foster pressure regulators. The order for immediate requirements includes six 8-inch—which is the largest valve the Foster Company has ever made for steamship service—eight 5-inch, and others of smaller sizes.

THE CLAYTON AIR COMPRESSOR WORKS, Havemeyer Building, 26 Cortlandt street, New York, have sent us a copy of their newest publication on the "Uses of Compressed Air." This list cites about seventy different applications of the air under pressure, and is a most convincing commentary upon modern advancement in engineering manufacturing and industrial lines.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has completed the new machine shop for the American Hard Fibre Company, at Newark, Del. It is 50 feet wide by 226 feet long, the roof being made of steel, and covered with anti-condensation corrugated iron roof covering. The same company has also just completed an addition, made entirely of iron and steel, to the works of the New England Electrolytic Copper Company at Central Falls, R. I.

THE GEO. F. BLAKE MANUFACTURING COMPANY reports that the Blake pump has been adopted by the Newport News Ship Building and Dry Dock Company for the U. S. gunboats numbers 7, 8 and 9, the contract having been awarded last week to the Geo. F. Blake Manufacturing Company. The contract includes Blake's special design of vertical duplex boiler feed pumps, fire pumps and bilge pumps; also an outfit of pumps for the distillers and evaporators.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J. in a recent circular gives some information in regard to the care of leather belts. It recommends the use of a belt dressing instead of tightening the belts wherever possible, and condemns the use of soap, resin, tar and tallow—castor oil also being criticized. Two cases are cited where the most excellent results were derived from the use of Dixon's belt dressing and leather preservative, which was the only article that would start the big driving belt used at the Paris Exposition in 1878 and keep it from slipping.

I. P. FRINK, 551 Pearl street, New York, in a new and handsomely bound and illustrated catalogue of 96 pages, describes different forms of Frink reflectors, which have achieved a national reputation. Among these are a large number of different designs for church lighting, and we note an illustration of the corrugated glass lined parabolic arc light reflector used with so much success at the Wild West Show. There is also illustrated a line of electric and combination fixtures, and a large collection of commendatory letters bear evidence to the claims made for the Frink systems of interior lighting.

THE LOUISVILLE ELECTRICAL WORKS, of Louisville, Ky., are soon to place on the market a transformer which they promise will surpass any other transformer made. Its particular virtues lie in its high efficiency, high insulation qualities and simplicity. It is the invention of Mr. Frank Culver, formerly assistant electrician of the National Electric Co., Eau Claire, Wis., who has recently associated himself with the Louisville Electrical Works in the capacity of superintendent and electrician. The patents on this transformer, which have just been issued, are, we are informed, quite broad, especially upon the construction of the transformer core and fuse devices.

H. C. JOHNSON & COMPANY, 114 Fourth avenue, Pittsburg, Pa., have secured the electrical construction of the Homestead Street Railway from the end of the Pittsburg & Birmingham line to and through Homestead, Pa., a distance of 5 miles, the Homestead & Highlands Street Railway, an extension of the Schenly Park and Highlands Street Railway from the old road to and through Homestead and Munhall, Pa., a distance of 5½ miles. Work has commenced and is being pushed through on the first named which will be completed in two weeks and cars run by December 10th. The last named will be commenced next week and it will be finished in 10 days.

J. GRANT HIGH & CO., Philadelphia, manufacturers of switches and switchboards, report having done three times more business last month than any month during their experience in business. Among some of the recent orders received for switchboards are the following: One board 10 by 15 feet, from the Baltimore & Townsington Electric Railway, Baltimore, Md; one marble board, 5 by 10 feet, for the William Mann building, Philadelphia; one board, 6 by 10 feet, from the Harrison estate, Glenside, Pa.; also large orders for switches from Cuba and one from Paris, France. The firm has opened an office at 80 Medinah Temple, Chicago, with Mr. W. N. Famous in charge, where a full line of its goods will be carried.

THE CRESCENT ELECTRIC MACHINE COMPANY, 647 Kent avenue, Brooklyn, manufacturer of the Churchward-Perry system of electrical apparatus, is congratulating itself upon the success met with in business since its reorganization last January. The incorporated capital was $20,000, all paid in, and has been increased to $70,000, of which $30,000 is paid in. This company has orders on its books now for $15,000 worth of apparatus. Mr. M. T. Davidson, the well known steam pump manufacturer, is the president of the company. Other officers are: Jas. F. Scholes, vice-president; Wm. D. Perry, general manager; Wm. A. Drewett, superintendent; Geo. F. Simpson, treasurer; Jas. S. Simpson, secretary and Alex. Churchward, electrician.

THE BALANCED LOCOMOTIVE AND ENGINEERING COMPANY, capital $1,000,000, was incorporated with the Secretary of State November 14. The objects of the company are to manufacture and sell boilers, steam engines, locomotives, etc., and to contract for and erect power plants. The stock is divided into 10,000 shares of $100 each, and the company's principal office will be in New York City. The directors are, Henry Warden, owning 900 shares of the stock, George D. McCreary, 100 shares, both of Philadelphia; George S. Strong, who takes 100 shares by subscription, and 4,500 additional to be paid for by property, and Joseph Bushnell, 10 shares, both of New York City; George S. Morison, 100 shares, of Chicago; James McNaughton, 100 shares, of Albany, and Robert G. Bushnell, 100 shares, of Morristown, N. J. Henry F. Taintor, of New York, and Henry G. Morris, of Philadelphia, as trustees for the bondholders of the Strong Locomotive Company, take 1,500 shares, which is to be paid for by property.

Business Notices.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 13, 1894. *

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

528,924. RADIATING AND SUPPLY SYSTEM FOR THERMO-ELECTRIC GENERATORS; H. B. Cox, Hartford, Conn. Application filed February 27, 1894. A thermo-electric generator having a heat-controlled pulsating controlling means for the liquid supply for the liquid cooling chamber of the generator.

528,925. ELECTRICAL TRANSFORMER; F. S. Culver, Eau Claire, Wis. Application filed December 19, 1893. This comprises a casing, an insulated coil, a core formed of sections of L-shaped plates clamped and inclosing the coil, non-conducting strips and binding bolts by which the coil and its core are secured in the casing.

528,959. INTERSECTING ELECTRIC RAILWAY TRACKS; M. Lowd, Salem, Mass. Application filed February 10, 1894. This comprises an intersecting rail having a tread of insulating material and a base of metal, the intersecting rail being in the path of the current collector on the car.

528,960. SELF-WINDING ELECTRIC CLOCK; A. Lungen, New York, N. Y. Application filed May 13, 1893. The combination of an electro-magnet, an electric circuit, a vibrating armature, a notched wheel engaged and moved by the armature, a circuit closing lever also engaging with the notched wheel, the armature engaging the circuit closing lever and lifting it out of engagement with the wheel before it engages and moves the wheel itself.

528,963. UNDERGROUND CONDUIT FOR ELECTRIC ROADS; E. A. Mathers, Romeoville, Ill. Application filed June 12, 1894. The combination with the conduit, of a trench below the same, supports mounted in the trench, rollers journaled in the supports, a belt carried upon the rollers, and mechanism for moving the belts.

528,972. ORE WASHER OR CONCENTRATOR; C. F. Pike, Philadelphia, Pa. Application filed April 6, 1894. The combination of a receiving vessel, a suction discharge therein, and a magnet at or near the inlet of the suction discharge.

529,058. TROLLEY WIRE HANGER; J. M. Andersen, Boston, Mass. Application filed July 19, 1894. The combination with an insulator to which the trolley is secured, a socket for the reception of the insulator and in which the insulator is capable of rotary and longitudinal movement, and means to lock the insulator in adjusted position against rotary movement.

529,059. ELECTRICAL APPARATUS FOR CONTROLLING SIGNALS; S. S. Bogart, Schraalenburg, N. J., and M. B. Leonard, Richmond, Va. Application filed December 11, 1893. The combination with the main line and its keys, of the visual signals, their locking armatures and local circuit devices, and a switch at each station comprising a depending rod provided with a retracting spring and cross arms constituting contact points.

529,080. ORE WASHER OR CONCENTRATOR; C. F. Pike, Philadelphia, Pa. Application filed April 6, 1894. The combination of a receiving vessel, containing a body of water, a jigger bottom therein, transverse riffles on the bottom, a feed and a discharge inlet for the vessel, magnets located adjacent to the bottom of the vessel, and circuit connections including a source of electric supply for the magnets.

529,085. ELECTROMAGNETIC MACHINE; G. J. Scott, Philadelphia, Pa. Application filed June 12, 1894. An alternating motor having an armature provided with a closed ring conductor and field magnets, to induce in the ring opposed currents in the direction of its circumferential length, and collectors bearing upon the ring at different points, displaced from the neutral plane to produce a distorted field and connected up in closed circuit.

529,117. REGULATOR FOR DYNAMO ELECTRIC MACHINES; J. Ferrand, Darnetal, France. Application filed July 3, 1891. The combination with a shunt dynamo, of a regulator having one or more carbon columns through which the exciting current passes.

529,127. BINDING POST FOR ELECTRIC INSTRUMENTS; E. A. Lowe, New York, N. Y. Application filed February, 1894. This comprises a spring wire helix surrounding and larger than the stem of the post and adapted to receive a connecting wire passed through between its convolutions and around the post.

529,144. AUTOMATIC SET BACK ANNUNCIATOR; H. C. Thomson and G. J. Galbraith, Boston, Mass. Application filed July 2, 1894. This comprises a pointer magnet, standard, sliding core, weighted lever spindle, sleeve, index finger, lift, an electromagnet with its armature pivoted upon ears, and an armature lever arranged to operate the lifting rod.

529,145. DYNAMO ELECTRIC MACHINE; R. Thury, Geneva, Switzerland. Application filed August 18, 1894. This comprises two horizontal and superposed rings, each provided with a coil and a circular pole piece, in combination with an axis bearing a bell, the inner wall of which is provided with ranges of teeth.

* Owing to the patent specifications being received two days late, it was impossible to have the usual illustrations made for this issue.

529,152. ELECTRICAL TRANSFORMER; F. Zickermann, Berlin, Germany. Application filed December 9, 1892. This comprises a core, a sectional primary element, a sectional secondary element, and means for simultaneously increasing or decreasing the number of sections of each element in series.

529,165. TRAIN OPERATED SIGNALING MECHANISM; J. H. Frischen, Berlin, Germany. Application filed November 28, 1893. This comprises a series of track contacts, circuits controlled thereby, a switching device adapted to successively close the circuits synchronously with the actuations of the track contacts, signal devices, circuits thereto, and means for controlling the closing of the circuits successively synchronously with the actuations of the track contacts.

529,174. MAGNETIC TELEPHONE; O. Higgins, Napoleon, Ohio. Application filed July 16, 1894. A magnet having spools upon each end of the same, a case covering the magnet, diaphragms at each end of the same, and caps secured at each end of the case, holding the diaphragm in place.

529,199. METHOD OF AND APPARATUS FOR CIRCULATING LIQUID ELECTROLYTES; P. Schoop, Zurich, Switzerland. Application filed December 29, 1893. The combinations with a vessel, electrodes and connections, of a passage formed on the inner side of the vessel, and establishing a communication between the upper and lower parts of the vessel.

529,203. TELEPHONE; J. Serdinko, San Antonio, Texas. Application filed April 28, 1894. The combination with the magneto call instruments, and the bobbin and diaphragm, of a soft iron induction piece fixed between the magnets and diaphragm, a portion of the piece projecting into proximity to the diaphragm.

529,213. ELECTRICAL CUT-OUT; D. F. Sweet, Grand Rapids, Mich. Application filed June 9, 1894. The combination of an electromagnet, an armature carrying an arm and pivotally supported, a roller journaled in the arm, a spring pressed arm carrying a knife edge bearing on the periphery of the roller, a cam for adjusting the armature, an indicating finger, a swinging frame carrying contact plates, a latch engaging the frame, and means for disengaging the latch by the action of the armature.

529,216. CONDUIT FOR ELECTRIC CONDUCTORS; J. Tatham, Philadelphia, Pa. Application filed March 17, 1894. This consists of inner and outer tubes of lead, and an interposed tube of insulating material rigidly confined between the inner and outer tubes.

529,240. ELECTRIC ARC LAMP; J. Brockie, London, England. Application filed June 18, 1894. The combination of the carbon holders, of a rocking lever and an undulating groove.

529,263. APPARATUS FOR EXTRACTING GOLD; J. B. Hannay, Loch Long, Scotland. Application filed November 15, 1893. This comprises a vessel with an insulating lining, a carbon zone embedded in the lining and connected with a positive terminal, a mercury cup in the bottom of the vessel connected with a negative terminal, a rotary agitator in the bottom of vessel, and valved outlet pipes arranged at different levels.

529,265. MEANS AND APPARATUS FOR DISTRIBUTING ELECTRICITY; H. T. Harrison, London, England. Application filed January 19, 1894. The combination with the primary and secondary mains and transformers, of circuit connections whereby the transformers can be thrown in and out of action, and electromagnetic contact devices for controlling the connections.

529,272. ALTERNATING CURRENT ELECTRO DYNAMIC MACHINE; M. Hutin and M. Leblanc, Paris, France. Application filed August 20, 1893. This consists in generating independent currents by and in accordance with the variations from synchronism, and thereby producing upon the rotating element a couple of forces opposed to the variations.

529,297. STOPPING APPARATUS FOR ENGINES; N. E. Nash, Westerly, R. I. Application filed April 25, 1894. This comprises a rotary valve in the steam pipe, a weight attached to the operating arm thereof, and a box to receive the weight, the arm being connected to a normally open circuit whereby it will be sustained by the weight until the circuit is closed.

529,300. AUTOGRAPHIC TELEGRAPH; J. O'Neil, New York, N. Y. Application filed November 27, 1893. This comprises a feed roll, means for moving same, a screw revoluble in opposite directions and placed parallel to the feed roll, a traveling nut upon the screw a stylus carried by the nut, and a motor to communicate motion to the screw.

529,313. ELECTRIC GAS LIGHTER; C. G. Savage, Philadelphia, Pa. Application filed June 13, 1894. This comprises an operating lever, an arm pivoted thereto but insulated therefrom, the arm adapted to come in contact with the lever on its forward stroke.

529,325. ELECTROMAGNET; C. C. Gerlach, Cleveland, O. Application filed December 9, 1893. A coil the surface of which is partially wound with flexible non-conducting material, in such a manner as to present alternately the covered and bare wire, and to admit an insulating medium between the strands.

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CONTENTS.

RESUSCITATION FROM ELECTRIC SHOCK.

The judgment expressed in the Electrical World in its issue of July 21st of this year, when announcing D'Arsonval's method of resuscitation from the apparent death that may follow an electrical shock, and the stress it subsequently laid upon the extreme importance of the matter, have received striking confirmation in the recent case at Pittsfield, Mass., where by its means a life was probably saved. The proof of the efficacy of this method is now so complete that no one following electrical pursuits in which there is danger from electric shocks, is justified in neglecting to make himself familiar with the D'Arsonval method of resuscitation. The necessary details have been given in practical terms by Dr. Goelet, only second in authority on the subject to D'Arsonval, in the valuable article printed several months ago in our columns, and which we reprinted in poster form for distribution. As an indication of the interest in the question among electricians, we may state that the first edition of the poster, consisting of 5,000 copies, has been exhausted, and an order for 500 copies has just been received from a large corporation for distribution among its employees. A second edition is now in press, and we shall be pleased to mail a copy to any of our readers upon application.

THE BOARD OF ELECTRICAL CONTROL.

The recent appointments of Mayor Gilroy to the Board of Electrical Control of New York City again directs attention to this worse than useless commission. From the beginning it has been a mere political machine; its origin, it is generally believed, was due to equivocal motives, and it signally failed in the chief object for which it was instituted—the placing of wires under ground, which was finally accomplished only through the personal efforts of Mayor Grant. There seems to have been no reason for extending the life of the Board other than for the purpose of retaining the offices for politicians, for every duty within its scope can be performed by its technical staff, Dr. Wheeler and Col. Kearney, under the direction of the Board of Public Works. In the proposed re-organization of the City Departments, the Board of Electrical Control should be one of the first to receive attention from the reformers,and be legislated out of existance, Col. Kearney whose competency is unquestioned, being transferred to the Board of Public Works. The following remarks by the New York *Tribune* are significant in view of the fact that two of the three members of the Board are of its political faith: "This Subway Commission has "been rotten with jobbery from its start. It has been filled with "political pets and parasites. The Mayor, by the appointments which "he announced yesterday, has not changed the general opinion that "the Commission is chiefly an embarrassment and obstruction and "a nuisance in public affairs in this town."

ELECTROCUTION.

In referring some months ago to the startling statement of D'Arsonval, that electrocution, as practiced in the New York State prisons, does not cause actual death, we remarked that this dictum, coming from such a source, could not be passed over lightly and should be tested by the state authorities at the first opportunity. We had in view the impression that would be created by such an authoritative utterance on the general public, and foresaw the opportunities it would afford to sensationalists. While we are opposed to the method of execution adopted as one abhorrent in its features and bringing discredit upon a great industry, yet we do not desire to have its repulsiveness increased in the minds of the public by the belief that, after all, real death is not produced by its application.

We therefore favor a scientific investigation not with any idea that the result will demonstrate that the criminal may be revived, but in order to definitely settle opinion on this point, and put an end to the deplorable sensationalism that the question has given rise to. We are, however, most decidedly opposed to placing the matter in the hands of those who are now exploiting it solely for the sake of a repellant notoriety which it would be shameful for the public authorities to gratify. The United States possesses a number of electro-therapeutists of high attainments and a committee selected from these should have charge of the investigation. We will repeat, however, that there is not the slightest probability that such an investigation would result in showing that an electrocuted criminal can be resuscitated. It is unbelievable that with the efficient arrangements in the New York prisons for subjecting the criminal for a long period to the terrific shocks of a high alternating E. M. F., there would not result lesions and destruction of nerve centres from disruptive stresses, and it should also be borne in mind that electrolytic effects may also be produced by the alternating current. Aside, however, from any hypothesis, the reports of post-mortem examinations of electrocuted criminals have shown that the death has been a true physiological one.

EFFICIENCY OF BOILERS AND ENGINES.

Elsewhere we print an instructive article by Mr. Geo. H. Davis on economy tests of electric railway plants, which enumerats the many details necessary in carrying out a complete test. We cannot agree, however, in the statement that we may expect in even the best of condensing plants an economy such as that indicated by the figures given. We do not mean to imply that such figures have not been reported as the results of tests, but we doubt very much if they can be obtained in power station work. An evaporation of 11.50 and 11.75 pounds of water per pound of combustible from and at 212 degrees corresponds to boiler efficiencies in the neighborhood of 77 and 78 per cent. respectively. The most authoritative boiler and engine tests recently made are those of the "Research Committee on Marine Engine Trials of the Institute of Mechanical Engineers," of which Prof. Kennedy is Chairman. In the tests of five sets of marine boilers the efficiencies were found to be 62, 62, 66.1, 67.2 and 69.2 per cent. respectively; the high efficiency in the latter case being due to the unusual ratio, 75, of heating to grate surface. It may be said that the boilers tested were not of the tubulous type, but it is questionable if the efficiency of the latter exceeds that of marine boilers under the ordinary working conditions of both. We are inclined to think that the engine efficiency is also overrated by Mr. Davis. In the new United States men-of-war the best economy attained with their triple-expansion engines has been 1.9 pounds of combustible per hourly indicated horse power, excluding all expenditures for auxiliary machinery. In the British tests above referred to, the consumption of combustible per hourly indicated horse power of three triple-expansion engines tested was respectively 1.82, 1.76 and 1.49 pounds, and of three compound engines, 2.65, 2.33 and 2.30, all exclusive of coal expenditure for air, circulating and feed pumps. It is true that, with the exception of one case, these efficiencies are low, but they are nevertheless the result of tests of the utmost accuracy by entirely disinterested and thoroughly competent engineers, which three conditions are rarely satisfied in tests as usually made.

REACTANCE.

In our issue of October 20 we printed a translation of an article contributed to *L'Industrie Electrique* by Prof. Blondel, in which he objects strongly to the definition for reactance adopted by the American Institute of Electrical Engineers. The main objection urged was that reactance, like other electrical terms ending in *ance*, should be a constant of a circuit and not include the effects of phenomena exterior to that circuit. In the same issue Messrs. Houston and Kennelly point out that the degree of fixedness of reactance in a circuit is, in any event, considerably less than that of inductance, and resistance and suggest that all confusion can be avoided by specifying "equivalent reactance" and "equivalent resistance" for the particular cases of mutually inductive circuits. By the use of this phraseology, they believe, not only will the objections of Prof. Blondel be overcome, but no violence will be done to the definition adopted by the Institute, which coincides, as far as the use of the term "relative reactance" is concerned, with the opinion of Prof. Macfarlane, expressed by him in a letter that subsequently appeared in our columns. In the present issue we print a communication to the Institute *Transactions* from Messrs. Bedell and Crehore on the same subject, in which the broad definition of the Institute is upheld. It is shown that by the definition favored by Prof. Blondel, reactance is only a constant of a circuit when it contains no iron, and, moreover, that the equation offered by him in illustration contradicts the definition by including the effect of hysteresis which, not being a wattless component, would therefore make reactance contain an energy component. The conclusion arrived at by these authorities is similar to that to which Messrs. Houston and Kennelly and Macfarlane were led, and this com promise will, we feel sure, be received in France in the same generous spirit in which it is offered. Briefly, it is proposed to retain the fundamental definition of reactance in the general form adopted by the Institute; in the case of circuits containing no iron, reactance may be defined as proposed by Prof. Blondel; in the cases where counter E. M. F.'s other than those due to capacity and self-inductance are present, the term "equivalent reactance" may be used. As remarked by Messrs. Steinmetz and Bedell, the term "reactance" is a happy one, not only in significance but on account of its international form. While it might be desirable for it always to retain the simple meaning which it has in non-ferric circuits, its use would thereby be greatly abridged, and we would be deprived of a much needed term to designate the reactive effects most met with in practical work.

Executions by Electricity.

The London *Electrical Review*, referring to the announcement that Governor Flower will permit an experiment to be made in order to determine if a criminal executed by electricity can be resuscitated, says that it feels sure, however greatly the public may have been shocked at the first effort at electrocution, that this kind of thing will meet with general and real protestations of indignation. It is perfectly well known at the present day, it states, that death is made swift and sure by the application of the electric shock, and this suggested experiment seems to it not only perfectly unwarranted, but utterly repugnant to civilized notions. "It looks almost as if the Hon. Roswell P. Flower has been made the catspaw of certain medical men, who probably have only their own ends to serve, public feeling being dragged in so as to lend weight to the barbarous notion. To try to resuscitate a man who has accidentally become the subject of an electrical shock commends itself to everybody; but in this instance we are confronted with what may be a very questionable experiment. If the shock is properly applied for a definite time there can be no doubt that the criminal will be killed; but who is to say whether the shock will not be deliberately applied in such a manner, and during such an infinitesimal period of time, the probable chances are that life has not actually fled from the body of the poor wretch? What then would his recovery prove but that he wasn't dead? We have overwhelming proof, from the practical demonstrations already carried out in American prisons, that electrocution is a speedy and certain end; if, therefore, it is intended that it should be so, the resuscitation of the tortured criminal would merely show that it had not been properly carried out."

Discussing Papers.

A paper read before an Institution of standing, but inadequately discussed, may often do more harm than good.—London *Electrician*.

Where Is It?

An English writer refers to an American electric railway on which, he says, there are 20 short circuits per day on an average.

The American Institute of Electrical Engineers.

At the regular monthly meeting of the American Institute of Electrical Engineers on Wednesday, November 21, Prof. George D. Shepardson read a paper entitled "Suggestions for an Index to Engineering Literature." After outlining what has heretofore been done in this direction, the conclusion is arrived at that one of the first considerations in the compilation of an index is the cooperation of a large number of people.

An efficient plan will require the expenditure of considerable money and would probably not be self-supporting, and it is thought that such work could probably best be done under the auspices of some society or societies. Prof. Shepardson advocates the combination of various national engineering societies to maintain the publication of an index which might thereby be made of lasting value to the engineering profession of the entire world, and since the headquarters of four of the national societies of this country are in the same city and two of these in the same building, Prof. Shepardson believes that such cooperation would not be difficult.

A plan is offered to carry out the objects of such a cooperation as that proposed, and some suggestions are added as to the style of such an index. Prof. Shepardson thinks it should include subjects relating to electrical, mechanical, hydraulic and civil, and perhaps mining, engineering; it should index books as well as periodicals; the references should be descriptive as far as practicable; each subject should have a page by itself; digest and simple reference might be on separate sheets; references and sheets on each subject might be numbered consecutively for convenience in adding later notes from other files or from later publications of the same articles; abbreviations or other symbols should indicate whether the reference is to original papers or reprints, whether the paper is in full or in abstract, and whether accompanied by discussions, plates or illustrations; the subject sheets should be separate and perforated for rearranging and binding, and should be printed on one side only, and might be printed on cards such as are used in the card catalogues of libraries.

Communicated discussions were received from Mr. Carl Hering, Mr. J. Stanford Brown, Mr. Max Osterberg and Prof. Goldsborough, and Prof. Houston, Prof. Crocker, Mr. Edward Caldwell, Mr. T. C. Martin and Mr. R. W. Pope, participated in the oral discussion. The labor required to keep up a personal index and its cumbersomeness after a time were referred to, and it was pointed out that the requirements of a current index and a general or reference indexwere different and in some respects incompatible. All favored, however, the compilation of an engineering index somewhat after the plan proposed, though the difficulties in carrying it out were recognized as being not inconsiderable.

In a communication Prof. H. J. Ryan expressed his satisfaction with the Institute definition of reactance, and dwelt upon the fact that it separated the energy and wattless components of impedance and gave the impedance and reactance formulas the same form as ohm's law.

The Definition of Reactance.*

BY C. P STEINMETZ AND FREDERICK BEDELL.

At the Philadelphia meeting of the American Institute of Electrical Engineers, May, 1894, the name "reactance" was officially adopted by the Institute and defined in accordance with a paper† on Reactance communicated by us and reprinted in most of the electrical periodicals. The action of the Institute was unanimous and its definition has met with general approval. Objection to it, however, has been raised in an article‡ recently communicated to a French periodical. Since we cannot agree with the arguments forwarded in this article, it will be in place for us to state our views thereon.

The definition of reactance adopted by the American Institute of Electrical Engineers is:

"Reactance is the component of electromotive force at right angles to the current, divided by the current."

By this definition the term reactance is the quotient of the reactive E. M. F. divided by the current, where the reactive E. M. F. includes all wattless E. M. F.s, whether due to inductance, capacity, polarization or counter E. M. F. of any kind, as of synchronous motors, and excludes all energy components, as would be introduced by motors, transformers, hysteresis, etc.

In objecting to this definition, the writer referred to, takes a position essentially as follows:

(1.) The term reactance shall include the effects of self-induction and capacity only.

(2.) It should always be defined by the equation

$$I = \frac{E}{\sqrt{R^2 + K^2}};$$

Where: I = current;
R = ohmic resistance;
E = electromotive force;
K = reactance.

(3.) For harmonic currents

$$K = \omega L - \frac{1}{C\,\omega};$$

Where: L = self-inductance;
C = capacity
$\omega = \frac{2\,\pi}{T}$ = pulsation.

(4.) The term "reactance" has a right to exist only because it is a constant of the circuit. Defined, however, as the quadrature component of E. M. F. divided by the current, it is the complex resultant of different reactions and not a constant of the circuit. All terms in "ance" should denote constants of the circuit, and whenever used in a generalized meaning, an additional term should be added, as "apparent reactance."

We may state that when investigating the question of properly defining the term "reactance," we have fully considered the position taken by this writer. We have, however, come to the conclusion that his definition is not tenable, but is contradictory, for the following reasons:

(1.) Neither in the one nor in the other definition is "reactance" a constant of the circuit, except in circuits containing no iron. In reality, circuits nearly always contain iron, and in such circuits the reactance can be considered as approximately constant only in a very limited range. When extended over a greater range of E. M. F. or of current, the self-inductance, and thus the reactance, varies. The same applies to most of the other quantities ending in "ance," as impedance, reluctance, and permeance, and thus the statement that quantities in "ance" should be constants of the circuit, is against the adopted practice and not fulfilled by either definition.

(2.) Where iron is present, the statement for harmonic currents

$$K = \omega L - \frac{1}{C\,\omega}$$

contradicts the definition of K by the equation

$$I = \frac{E}{\sqrt{R^2 + K^2}}$$

R being taken by the ohmic resistance and K as reactance. This is due to the presence of hysteresis. These relations do hold in the absence of iron, and such cases were taken by us in our paper to illustrate the definition for simpler cases; the fundamental definition, however, should in our opinion be sufficiently general to include circuits with iron. Consider an harmonic current flowing in a circuit embracing iron; for simplicity assume capacity absent. The last equation would not give any direct relation between the inductance and reactance, such as would be obtained from the equation just preceding, but would make reactance still a more complex quantity, by including therein not only the effect of self-induction but that of hysteresis as well. Furthermore, it would lead to the result that the reactive E. M. F. is not wattless, but includes an energy component, an idea quite foreign to the term.

These considerations obliged us to discard any indirect definition of reactance by means of the term inductance, and to adopt the more direct definition analogous to the definition of resistance.

The definition of resistance is Ohm's law:

$$R = \frac{E}{I},$$

where E and I represent an unvarying E. M. F. and current, respectively.

Considering E and I as an harmonic electromotive force and an harmonic current—or in the case of alternating quantities which are not simple harmonics, as their equivalent harmonic values, that is, values of equal square root of mean square value and equal power—the above equation gives the definition of impedance:

$$\text{Impedance} = \frac{E}{I}$$

Our proposed definition for reactance is analogously written:

$$\text{Reactance} = \frac{\text{reactive } E}{I}$$

*From the November issue of the *Transactions* of the American Institute of Electrical Engineers. Communicated October 31, 1894.
†The Electrical World, June 30, 1894.
‡The Electrical World, Oct. 20, 1894.

Further, we may define the equivalent resistance of the circuit by the expression

$$\text{Equivalent resistance} = \frac{\text{power } E}{I}$$

In the absence of expenditure of energy outside the electric conductor, this quantity coincides with the true ohmic resistance.

These quantities are thus defined directly, and in a uniform manner. How far these quantities are constants of the circuit depends upon the circumstances; in any case reactance and impedance depend upon the frequency.

The phenomena taking place in an alternating current circuit cannot fully be represented by the terms: ohmic, resistance, inductance, and capacity, but a further term has to be introduced, representing the losses of energy outside of the electric conductor, as hysteresis, etc., and the most satisfactory way to do this appears to us to bet the generalization of the term "resistance" to "equivalent resistance."

The use of "equivalent" values for quantities is employed in the paper on "The Law of Hysteresis, III." In the discussion of this paper at the Philadelphia meeting the significance of these values is pointed out.

Wherever the reactance is generalized to include active counter E. M. F.'s., it may well be distinguished by the denotation "equivalent reactance."

We would emphasize the utility of two rectangular components, whether E. M. F.'s or currents are resolved. Reactance should always, in our opinion, be associated with that which represents no expenditure of energy, the reactive E. M. F. being at right angles to the current and the reactive current (the wattless current) being at right angles to the E. M. F. Whether we resolve currents or E. M. F.s' depends upon the problem in hand; each method has its advantages. If we resolve the current, we may write:

$$(\text{Current})^2 = (\text{power current})^2 + (\text{reactive current}).^2$$

Divided by E, this gives:

$$(\text{Admittance})^2 = (\text{conductance})^2 + (\text{susceptance})^2,$$

for a simple case; in general, for conductance and susceptance we should write equivalent conductance and equivalent susceptance. Admittance, conductance and susceptance as thus used are the inverse correspondents of impedance, resistance and reactance, and may be added as vector quantities. Many alternating current problems are much simplified by this treatment. It is important, however to employ components which are at right angles to each other, and for this reason the definition of the American Institute of Electrical Engineers seems preferable. It is in this point that the definition is fundamentally different from that of the French writer already referred to. In the absence of hysteresis losses, the definitions would be the same, applying the term equivalent reactance to the case where the counter E. M. F.'s other than those due to capacity and self-induction, are present. To conclude then, we may say that in the absence of iron we may define reactance in terms of inductance and capacity, as this writer has done, and as has been done by us in the illustrative examples in our paper; the fundamental definition, however, should, in our opinion, remain in the general form adopted by the American Institute of Electrical Engineers.

In a note to our original paper we have called attention to the first suggestion of the term reactance by M. Hospitalier in May, 1893, and the recommendation of the committee appointed by the Société Internationale des Electriciens to consider the programme for Chicago Congress, 1893. The term is a happy one; it is international, and uniformity in its use is to be desired.

In our opinion the best definition for "reactance" is that adopted by the American Institute of Electrical Engineers. In this, as in all matters, there is, however, room for difference of opinion. The reasons for thus defining the term have not before been published, but we believe that when they are duly considered, the action of the Institute will meet with International approval.

Agricultural Electric Railways.

A meeting was recently held at the office of the London Chamber of Commerce of those members of the chamber interested in the question of the construction of light railways for agricultural purposes in England; the meeting having been called together for the purpose of electing delegates to attend the conference which is to be held at the Board of Trade with a view to the drawing up of regulations. An interesting discussion took place, in the course of which the advantages of electricity for the purpose in view were insisted on by many speakers. It was generally thought, at any rate at first, that some form of government or parochial pecuniary assistance would be required.

The Future of the Storage Battery.

At a dinner given at the "Waldorf" and attended by gentlemen interested in the development of electricity, Mr. Frank W. Hawley, well known for his pioneer work in the application of electricity to the propulsion of canal boats, in responding to a toast "Storage Batteries," dwelt upon the great field for the perfected storage battery.

One of the most perplexing problems connected with electrical development, he said, has been the invention of a perfect storage battery. Much thought and labor have been expended on the subject by chemists and electrical experts, but the results have not been what could be wished. Great improvements, however, have been made, and we can reasonably hope that the near future will produce a battery that will meet all the requirements of science and of commerce, which hope is strengthened by recent statements of Prof. Ostwald, the great German authority on electro-chemistry, and others. As soon as a good storage battery is put upon the market, we shall see the steam locomotive discarded and electricity become the great motive power. Such batteries would be suitable for canal propulsion, and would meet with ready adoption on the street car lines of our cities.

Mr. Hawley referred to the growing use of storage batteries in connection with electric light and power plants. These must otherwise have a generating apparatus sufficient to supply the maximum demand; a demand which continues but a small part of the day. For the balance of time the plant must be operated at a fraction of its capacity and consequently at a loss. But these batteries enable a smaller plant to run on full time, and meet all the demands made upon it at any period of the day. They also enable it to store by day a sufficient quantity for each night's requirements.

Attention was called to the utility of storage batteries as safeguards against any failure of electric supply. They will be a wise precaution when electricity comes into general use for domestic and power purposes. They might also be employed wherever currents are received by overhead wires, since such exposed lines are always liable to be damaged by the elements. Mr. Hawley does not, however, consider them absolutely necessary, but only as a possible convenience. It is not likely they would be required where electricity is conducted over cables enclosed in an underground subway. It is difficult to imagine the possibility of such wires failing to properly transmit currents, particularly in the light of past experience in electrical distribution.

In no way, he stated, is the superiority of the present age more manifest than in its ability to control the powers of nature and vend them in the market place. Oil has long been sent to the great cities by means of pipe lines, and to remote districts in tank cars. Electricity will be similarly distributed. It will be flashed over leagues of space on cables following the highways of commerce, and storage battery cars having an enormous capacity will be constructed and charged either at generating stations in the coal districts, or at stations where the current is generated by water power. These could be sent to their destination just as oil cars now are, and their contents delivered to local distributing stations, or directly to lighting and power mains.

Mr. Hawley directed attention to the fact that in nearly every State in the Union there are great deposits of coal so poor that it would not pay to mine and transport by land or water. But if a generating station should be located at those mines, the poor coal could be transformed into electric energy, stored in such cars as referred to, and shipped to sections where a direct current could not be sent. In the lumber districts of Michigan, also, it would be entirely practicable to erect portable generating stations, where refuse timber could be worked up, affording power to operate mills or for any other need, and the surplus could be similarly transported elsewhere for light, heat and power purposes.

These, he concluded, are some of the numerous uses that could be made of the perfected storage batteries. When once in successful operation, countless other uses will be found for them. Electricity has shown itself capable of infinite service, and its field is daily widening. It can bear thought on its rhythmic wings around the globe; carry the human voice hundreds of miles; deliver messages on board moving trains; flash into dazzling splendors along city thoroughfares; light the abyss of the ocean; operate countless automatic devices; warm us when cold; fan us when heated, and treasure up and repeat all sounds and harmonies. At the summons of inventive genius it has outwrought the dreams of magic. It would, therefore, be idle to say that the end is yet.

Notes on Economy Tests of Electric Railway Plants.

BY GEO. H. DAVIS.

Assuming that a complete test is to be made, the parts that should receive particular consideration are the boilers, the furnace, the steam piping system, engines, condensers, pumps, water piping system, generators, line work from switchboard to terminus of road, motors and track bonding.

It is not intended in what is said here to mention details for the testing of each part of the system. All these things are explained in a most perfect manner in the reports of the American Society of Mechanical Engineers, in "Engine and Boiler Trials," by Dr. R. H. Thurston, and in "Experimental Engineering," by Professor R. C. Carpenter. In these publications may be found all the blank forms necessary for the taking of data, and the results of the complete test calculations, all equations and formulas, and a thorough description of all instruments and their uses.

A few notes with particular reference to railway plants may be of interest.

The tests of different parts must be made simultaneously in order to locate defects in the system of power generation, conversion and transmission, since the conditions are constantly changing. Two tests, one on a constant load and one on a variable load, are always necessary. The variable load trial proves the efficiency of the parts under actual conditions, and for the particular kind of work they are doing. An engine may be so designed and proportioned as to do perfect work in a flouring mill, and also be a total failure in a railway plant. This, in a less degree, is true of boilers and steam fitting. It is plain also that a variable load test is the only one that is at all valuable to the railway company since they have no interest in the economy of the parts outside of the particular duties assigned to them; however, as a check on the work, a constant load test should always be made, because in it greater accuracy can be maintained.

It is always difficult to take readings on variable loads, and the first consideration should be to take them exactly on the second. Boiler room readings may be taken at intervals of five minutes cards should be taken from the engine at intervals of two and a half minutes, with about two tracings on each card, generator readings being taken at the same time, while motor readings may be taken as frequently as each fifteen seconds.

Definite plans for a test must always be made and strictly adhered to; no details can be overlooked without causing serious inaccuracies in the results obtained. The changes in pipe fittings and all preparations for a test must be carefully studied and a sufficient number of reliable men employed, because, if one man fails to do the work assigned him, the entire results may be wholly without value. One competent man should be assigned to the duty of doing nothing except to see everything and remember all that he sees. His information will be valuable in working up the test.

In the preliminary work engine valves should be carefully adjusted and the interior and exterior of the boilers personally inspected, as the least coating of soot or scale makes a large difference in the evaporation. All piping values must be carefully tested, and if any faults are found the valves should have blanks inserted.

The three most accurate men should be assigned to the duty of weighing water and coal and reading voltage and amperage at the switchboard, because these three items form the foundation for the test.

A set of friction cards should be taken at the beginning and another at the end of the test, the final set forming the basis for friction calculations.

The instruments and appliances needed are at least two pyrometers, a barometer, scales and tanks for weighing water and coal, apparatus for flue gas analysis, case of thermometers and thermometer cups, two or three calorimeters, with taps for steam pipes, draught gage, condensing coils and tanks for the measurement of hot drips, speed indicators, engine indicators and attachments, standard steam and vacuum gages, Weston voltmeters and ammeters, a rheostat or tank of water large enough to consume the maximum current, a portable Wheatstone bridge (or the fall of potential method may be used in measuring resistances since they are usually small), a spring balance and some form of dynamometer and tachometer for car tests. All these instruments must be carefully calibrated and a preliminary run made previous to the first day's test.

The constant load test should be made first, because in this readings would be nearly uniform and taken at much longer intervals, thus giving greater opportunities for accuracy. It will also serve to initiate the men who, perhaps, are not accustomed to reading instruments accurately and quickly.

The object of the whole railway design is to convert the heat energy of coal into mechanical energy at the car trucks, and for this reason, in making an economy test, every possible loss of heat should be traced to its source. Thermometers should be placed everywhere, as a steam plant test is practically a heat test. If power house windows have to be open in the winter to keep the building cool it is certainly profitable to know the source of the loss. Heat losses in a plant of this kind are: (1) Heat discharged from the flue. (2) Heat discharged in condensing water; and (3) Radiation and convection from the entire system.

For example, in a large station there are 1,200 square feet of superficial area in the high pressure piping and reservoirs containing high pressure steam. Aside from this area there are those of the heaters, hot water system, and drip system. The steam pressure usually carried is 125 pounds gage, average temperature of surrounding air about 75 degrees F., difference in temperature between steam and air being about 277 degrees F. In experiments on bare wrought iron pipe conducted at Cornell University, under the direction of Professor R. C. Carpenter, it was found that the loss due to convection per square foot per hour in a four-inch pipe at the given difference of temperature to be 425 B. T. U. The losses due to radiation 340 B. T. U., making a total of 765 B. T. U. This would make a total loss in the entire system of high pressure pipe of 918,000 B. T. U. per hour, equivalent to about 65 pounds of coal, equivalent to about 30-horse power at the switchboard per hour.

With a covering on this system of one inch of magnesia and one inch of hair felt, the losses as shown by calorimeter tests were only ten per cent. of the above, making a difference for annual operating expenses for the high pressure pipe alone of $480.

In the summer season the power house should be as cool as a machine shop. The extra coverings necessary to make it so will save enough fuel to pay many times the interest on their cost. It is a mistake to allow twenty or thirty-horse power of heat at from $20 to $30 per annum to pass out of monitor windows. In fact, monitor windows should not be necessary. Enough heat is wasted in some large plants by radiation and convection losses to pay for an additional inch of hair felt over every square foot of exposed high pressure area.

Therefore, in making an economy test, it should not be neglected to place thermometers outside the building and in the engine and boiler rooms. They should be placed on the outside of pipe coverings, engine cylinder jackets and outside of coverings for boiler drums and fronts, besides in the usual places required in a test.

By knowing the temperatures and the superficial area of pipes we have a check on losses due to radiation indicated by calorimeter tests. Calorimeters, as instruments, tell most accurately the quality of steam passing through them, but this steam may not be of the same average quality as that passing through the main. It entirely depends on the form and position of the top pipe used. A spiral pipe used inside the main, being perforated to correspond with the amount of steam passing each point, should give the best sample of steam. But since its form is very inconvenient in placing, the standard form is practically best.

If a careful calorimeter determination is made at the nozzle of the boilers as to the amount of priming water carried over, then it becomes easy from the measurement of drips to determine the loss due to radiation.

The drips can be measured by drawing the water off at a point under the surface of the condensed water in the separator and passing this mixture of water and steam through a condensing coil. The steam appearing in the drips being re-evaporated water due to the change of pressure from that of the separator to that of the atmosphere.

If the unit to be tested is direct belted, speeds of both engine and generator should be taken if possible with a continuous counter, so that belt slippage can be accurately determined. Tests of both direct connected and direct belted units show that there is a loss in large belts of this class not usually accounted for. It probably results from the great and sudden variation of loads in the generator, the thickness of the belt, and the wave motions which are not found in steady loads. Certainly the loss is much greater than that found in woolen mills and flouring mills.

In the generator tests temperatures should again be taken of armature fields and bearings, and a voltmeter and ammeter used on the field circuit both shunt and series, and at the end of the constant load test a characteristic curve of the generator may be taken.

The water rheostat commonly used, consisting of a large tank with copper plates for positive and negative terminals, is practically best. This should be exceedingly well built since the water in it rises to

. temperature of 212 degrees, and a flimsy structure will surely burst, interrupting if not spoiling the test.

With reference to motor tests, a voltmeter should be placed across the terminals, and another from trolley to trucks, and an ammeter inserted in the main circuit. A tachometer should be attached directly, if possible, to the armature shaft; a straight edge 10 feet in length, with a level inserted, and pivoted at one end, will serve to give the approximate grades. Readings each fifteen seconds of ammeter, voltmeters, tachometer level, with times of each, with street and street crossings noted, and such extra notes as should be frequently taken give us all that is of immediate practical value.

If a test of efficiency of gearing is required, the car may be blocked up and a Prony brake applied, first to a pulley on the car axle and next to a pulley on the armature shaft, voltage and amperage being read with those of the brake; from these readings the losses can be deduced.

In the measurement of resistances, such as joints in feeder wires, contacts between trucks and rails through a sand or dirt coating, sections of track bonding, etc., the fall of potential method, using high resistance Weston voltmeters and ammeters, is the most satisfactory. The same method may be employed in the measurement of total overhead line resistance.

The losses due to sand on rails are great as is plainly shown by placing one terminal of a voltmeter in contact with the car truck and the other on a clean portion of the rail. This drop in potential between truck and rail varies greatly, and is often in dry weather a source of greater loss than poor track bonding. An easy way to determine this fall of potential when the car is running is to attach one terminal of the voltmeter to the trucks and the other to a small wheel with a sharp flange, having a handle sufficiently long so that from the rear of the car this wheel can be held on the rail. The knife edge flange will push aside and penetrate any coating of sand, besides cutting through a coating of dirt which is always found clinging closely to the rail surface This coating, which is found in filthy streets, does not form so great a resistance as sand, but at the same time is a source of loss, and also very hard to remove from the rails.

From the more or less complete tests which have been made during the past four years, it is quite clearly indicated that the following standards of economy are not too high in the best condensing plants:

Equivalent water evaporated per pound of combustible from and at 212 degrees F....................11.50 to 11.75 pounds.
Loss in high pressure piping system, due to convection, radiation, etc...........................1 per cent. to 1.25 per cent.
All heat losses aside from heat discharged from furnace flues and from condensers................15 per cent. to 2 per cent.
Pounds of combustible per indicated horse power per hour, constant load...1.5 to 1.75
Total friction of engine, belt and generator, .15 per cent. to 20 per cent.
Electrical resistance of double track return circuit, per mile .02 to .03 ohms.

The complete test should be made on an "average day" in the operation of the road. Complete records of the operations of all cars, their weight, etc., all generators, engines and boilers, aside from those under test, should be kept. This data, with the regular test readings, will furnish all that may be required in giving a most satisfactory knowledge of the equipment and a basis for the recommendations of all changes in operation, which the test should indicate.

Equivalent Sine Curve.

In the discussion of the Philadelphia meeting of the American Institute of Electrical Engineers, printed in the November number of the *Transactions*, Mr. C. P. Steinmetz defined the equivalent sine curve as a true sine wave of current of the same frequency as the fundamental, the same effective intensity as the total distorted wave, and shifted against the equivalent sine wave of electromotive force by such an angle that its power in watts equals that of the distorted wave. The equivalent sine wave is not identical with the fundamental sine wave, except in the case where the sum total of higher harmonics is wattless, because the equivalent sine wave includes the energy of the higher harmonics also, and thus the remainder, or the difference between the distorted wave and equivalent sine wave generally includes a component of the same frequency as the fundamental. Resolving a distorted wave into an equivalent sine wave, and a wattless remainder is not identical with resolving it by Fourier's theorem into a series of sine waves, because the equivalent sine wave is not the fundamental component of the total wave, but a wattless remainder of apparently triple frequency may contain a term of simple frequency. To fix a definition of this equivalent sine wave it is "a sine wave of equal effective intensity and equal power with the true wave." If you take a wave of electromotive force, for instance, and a wave of current, then the higher harmonics may, but need not, be powerless. This is especially the case if you have the current distorted by hysteresis

Mr. A. E. Kennelly, in the course of some remarks, said that when the current is no longer a sinusoidal wave, if it becomes distorted by the action of iron in the circuit, it is a complicated wave. But the ammeter or dynamometer which is used to measure that distorted current, will show some effective current strength which might be attributable to a pure sinusoidal current. It would show a current strength in amperes which would be represented by a sine curve, so that the real current, whose shape can only be determined by a long series of experiments, has an equivalent representation in the dynamometer such as would be produced by a current of the pure sine shape. But if you do not carry the magnetization too high—beyond 10 kilogausses—the amplitude of the pure sine wave, such as the dynamometer would lead you to suppose exists, and the amplitude of the actual distorted wave, are equal.

In our last issue we printed the remarks of Dr. Bedell on the same subject.

Symbols and Abbreviations.

The following is from the London Electrical Review of Nov. 16:

Referring to the letter which we reproduced in our last issue, from the *Electrical World*, we should like to offer some remarks. The writer says that one of the fundamental principles (by the way, we have never yet seen any authoritative enunciation of these so-called principles) of the Congress system is "to use script or oblique letters as symbols for quantities and perpendicular letters for the names of units or their abbreviations." Now, script letters such as those shown both in the *Electrical World* and in this paper are *perpendicular* letters. If it was necessary then to substitute perpendicular letters at all for oblique ones, we cannot see any valid reason whatever for preferring script to block letters. For ease in reading and in writing, the latter are very much to be preferred, though strange to say, M. Hospitalier seems to think otherwise. The greatest practical use which will be made of any system, apart from books, will be by the large army of professors and lecturers, and the time which would be saved to them and their students by the adoption of the easy **M** and **H** instead of the troublesome French script, is a matter of some consideration. One thing is certain, that they would have to learn how to write a new alphabet. Apart from this, the block letters have been and are being used by nearly all the leading writers on magnetism of the present day. Ewing, Fleming, and S. P. Thompson, all use them in their well-known works; and *mirabile dictu*, the secretary of the committee which recommended the use of *script* letters, Prof. Nichols, of Cornell University, in his newly published *Laboratory Manual of Physics and Applied Electricity*, himself uses repeatedly, between pp. 201 and 205, *block* letters to represent magnetic quantities. Regarding the vexed question of C or I for current strength, we are decidedly of opinion that to use I would oblige teachers to explain the French use of the word "intensity," and that this would lead students to form a totally wrong idea of what strength of current actually means. In short, as Prof. Jamieson has tersely put it in his strictures on the Committee's recommendations, this word "intensity" has *no meaning* to English speaking people when used in this sense, and would very likely never be used. Why then prefer the initial letter of "intensity," a word which will never be heard, before that of the word "current," which is in constant use by British, Americans, and foreigners alike? If the American Institute of Electrical Engineers adopt the symbol I to represent current, they will prove false to the recommendations of their own Badge Committee, which, in the face of the recommendations of the Congress Committee, adopted as *their* mystic symbol, the well-known formula $C = \frac{E}{R}$. (For illustrations, see the *Electrical World*, December 2, 1893, p. 424). Does this not look somewhat like a tacit vote of censure? It is evident that Prof. Macfarlane agrees with Prof. Jamieson's suggestion about the use of the solidus (/) instead of the colon (:) for *per*. In regard to his other objections, we may take another opportunity of discussing them more in detail.

Extracting Teeth Electrically.

A London dentist extracts teeth by giving the patient such a strong current of electricity, with the tongs in circuit that, in his agony, he forgets all about the tooth The dentist calls this a painless extraction of teeth.

The Sag in Span and Trolley Wires.

BY E. A. MERRILL.

In order to determine the proper height of eye bolts or span wire supports above the track when the height of the trolley wire at its lowest point is specified, it is necessary to know the dip or sag in the trolley wire due to its own weight, and also the sag in the span wire due to the combined weights of span wire, trolley wire for one half of each of the adjoining spans, and hanger; the sum of the two sags plus the distance between the trolley and span wires will be the amount to be added to the specified height.

For the purpose of determining these quantities accurately a series

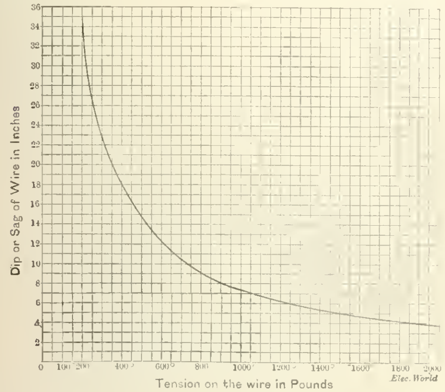


FIG. 3.—DIP OR SAG OF NO. 0, B. & S., TROLLEY WIRE (COPPER) IN A SPAN OF 125 FEET AND WITH VARYING TENSIONS (PLOTTED FROM ACTUAL TESTS).

of carefully conducted tests was made for the Pierce & Miller Engineering Co., by their superintendent, Mr. H. R. Conklin.

Believing that the results of these tests will be of considerable interest and value to many engaged in engineering or construction work they are given below in Figs. 1, 2, and 3.

Fig. 1 represents the usual conditions occurring in single track work, viz., a hanger suspended from the span wire at approximately its middle point, and supporting 125 feet of No. 0 B & S copper trolley wire; the entire weight of the suspension being about 42 lbs. In the test the span wire used was seven strand galvanized signal strand $\frac{5}{16}''$ in diameter, and a weight of 42 lbs. was suspended midway between the supports to represent the combined weight of trolley wire and hanger. The spans were varied from 30′ to 120′, and the strains from 250 lbs. to 3,500 lbs.

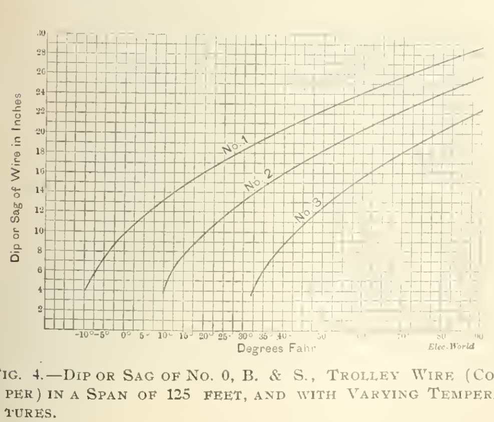


FIG. 4.—DIP OR SAG OF NO. 0, B. & S., TROLLEY WIRE (COPPER) IN A SPAN OF 125 FEET, AND WITH VARYING TEMPERATURES.

If we have the length of the span and know the maximum strain desired on the poles, we are given in these curves the sag in the span at its lowest point. For example suppose we wish to know the sag in a 60-foot span with a strain of 1,000 lbs. on the side poles. Starting at the 1,000 lbs. strain line we follow up to its intersection with the 60-foot span curve and then to the left where we find the sag to be 9 inches.

In the same manner we can find any one of the three quantities if two are known or can be assumed.

Fig. 2 gives similar data for double track work. In this case two weights, weighing 42 lbs each, were suspended 10′ apart and equi-distant from the side supports; the spans and strains being varied as in Fig. 1.

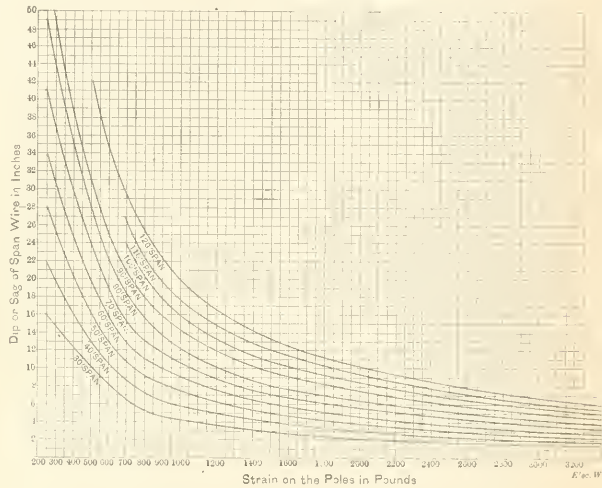


FIG. 1.—DIP OR SAG IN SPAN WIRES, SINGLE TRACK (PLOTTED FROM ACTUAL TESTS).

The curves are probably as accurate as it is possible to make them, as the readings were made with a surveyor's level; for all practical purposes, however, the empirical formulas given below are sufficiently accurate, the error being entirely negligible, at least over the limits of the curves

Fig. 3 gives the sag in a span of 125 feet of the standard No. 0 B & S hard-drawn copper trolley wire under tensions varying from 200 to 2,000 lbs. The tests were carried no further than 2,000

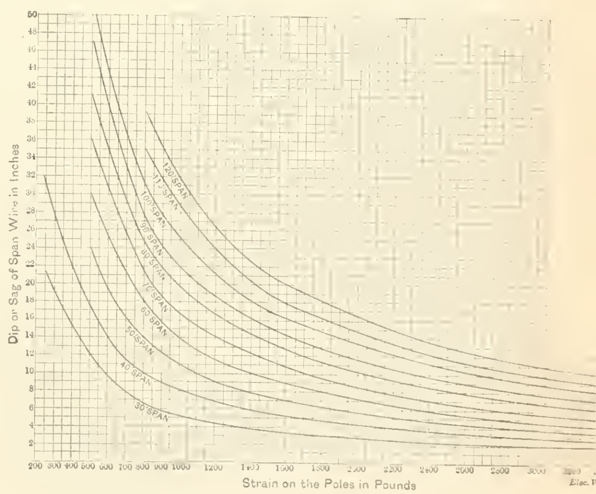


FIG. 2.—DIP OR SAG IN SPAN WIRES, DOUBLE TRACK (PLOTTED FROM ACTUAL TESTS).

lbs. as it is believed that this is the maximum safe working limit, the elastic limit of a line employing soldered clips probably not exceeding on an average 2,000 lbs., and the ultimate tensile strength probably not exceeding 2,800 lbs. If it is desired to carry the limits further the formulas given below for Figs. 3 and 4 can be used; for

it is found that the catenary curve $D = \frac{3wl^2}{2T}$, in which w is the weight of the wire per foot of length, and the curve plotted from tests do not materially differ.

To find the total sag it is only necessary to add the span and trolley wire sags as taken from the curves or forumlas, and to this to add the distance between the trolley and span wires, which will vary from 2 to 5 inches with different types of hangers.

There is yet one important element to be taken into consideration which the tests do not include—the variation in sag, and consequently strain, due to varying temperature. In the case of span wires this is generally unimportant as there is sufficient elasticity in the poles to compensate for it; but in the trolley line we have very little elasticity and the result of pulling up a line too taut in summer is either to necessitate splicing a break after every cold snap, or pulling the curves back over the track in the spring if the line has not been securely anchored, perhaps both.

Fig. 4 gives this data in three curves. No. 1 shows the variation in sag assuming that the lowest temperature will be $-10°$ F., No 2. for a minimum temperature of 10° F. and No. 3 for a minimum temperature of 32° F. In each case the tension on the wire at the lowest temperature is 2,000 lbs. For example, if the sag at 10° F. is 3.73 inches and the tension 2,000 lbs., the sag at 80° F. will be 24.1 inches, and by reference to Fig. 3 it will be seen that the tension has fallen to 290 lbs. Therefore, if the trolley wire is put up when at a temperature of 80° F. it should be allowed to have a sag of 24.1 inches at its middle point if it is expected that during the winter its temperature will fall to 10° F.

The formula for these curves is $D = \sqrt{8.1\ t + 14}$ in which D is the dip or sag in inches, and T is the number of degrees F. by which the actual temperature exceeds the temperature at which the tension is assumed to be 2,000 lbs. For example we will assume the minimum temperature to be 10° F. and the actual 80° F., the difference is 70 and the formula becomes

$$D\ l = \sqrt{(8.1 \times 70) + 14} = \sqrt{567 + 14} = \sqrt{581} = 24.1 \text{ inches.}$$

Since the tension varies inversely as the dip, the above formula can be used for any maximum tension by proper substitution. For example, if we assume the maximum tension to be 1,500 lbs. the value of D will be $\frac{2}{1.5}$ times the value given by the above formula for any temperature, and the forumla becomes

$$D = \frac{2}{1.5}\sqrt{8.1\ T + 14} = \sqrt{14.4\ t + 25}$$

Resumé of formulas:

D = dip in inches;
l = length of span in feet;
S = strain on poles in pounds, from 250 to 3,500 lbs.
t = number of degrees between actual temperature F. and the temperature at which the tension is 2,000 lbs.
T = tension in pounds.

Dip or sag in span wire—

SINGLE TRACK (FIG. 1).

$$D = \frac{l}{S}\left(120 + \frac{l}{2}\right) \text{ (Empirical).}$$

DOUBLE TRACK (FIG. 2).

$$\left.\begin{aligned} D &= \frac{l}{S}(160 + l) \text{ up to 100 feet} \\ D &= \frac{l}{S}(150 + l) \text{ from 110 to 130 feet} \end{aligned}\right\} \text{(Empirical).}$$

Tension on trolley wire (Fig. 3):

$$T = \frac{7{,}477}{D}$$

Dip or sag in trolley wire (Fig. 4):

$$D = \sqrt{8.1\ t + 14}$$

The formula for Fig. 3 is derived from the catenary formula given above by substituting the value of w and l.

High Candle Power Gas Rivalry

BY H. W. FRUND.

Among the topics coming to the attention of the general manager is the periodical appearance of the Auer (Welsbach) gas burner. This burner, which has appeared and as quickly disappeared from the public during the past eight years, is now again being actively pushed and introduced, especially in towns and cities where gas and electric competition is fierce. It may not be amiss to state that this burner is not new as represented, and that its history dates back to 1880, when Carl Auer, then a pupil of Prof. Bunsen at the University of Heidelberg, became interested in the subject of illumination and soon thereafter invented the burner, which at best is not pretty, and emits a ghastly gleam suggestive of the whited sepulchre. It is also the same old gas, the light remains naked and the results of combustion remain just as deleterious and more poisonous than ever. The Journal of the Franklin Institute, English and French contemporaries, comment unfavorably upon this burner. Herr. v. Ohechelhauser, in his lecture on the gas industry in the United States, at Karlsruhe last June stated "The old burners of both Fahnehjehn and Auer proved failures in America."

The first trial of consequence of the Auer burner has been during the past two years in the gas belts of Indiana and Ohio, where the burner has proven a dismal failure with natural gas. The results with manufactured gas last winter are claimed to have been better—strange to say, however, only in cities where electric companies run at all hours, the competing gas company struggling as it were to hold what few customers it might have.

Prominent gas engineers claim that while the lighting power of gas has had to be increased, the Welsbach burner in legitimate competition with electricity is a failure and would prove the greatest bane to gas companies. Where competition has been greatest, managers from their experience and observation on this point say: "This new burner when it was first introduced created quite a furore, and caused some little anxiety among our stockholders. After being in use about one year we find it is losing its popularity, as experience has demonstrated that it deteriorates faster than the incandescent light. After burning about 100 hours it does not give as much light as a 16-cp. incandescent. It is also a great consumer of oxygen and gives more heat than the ordinary burner. It is very frail and delicate to handle, the sulphur from a match oftentimes breaking the thin gauge. We find them overrated to the extreme, using about 9 ft. of gas per hour when new, and giving about 42 cp. After using 4 weeks the same burner and with the same gas pressure we got only 15 cp. with a consumption of 11 ft. of gas. You will have to look out for all kinds of trickery. For instance your competitor will go to your customer, and after finding out their contract rate for electric light will guarantee them a saving of 40 per cent. if they will put in the Welsbach burner, and also put them in on 30, 60 or 90 days trial. In the meantime they will underrate the gas meter until they have apparently demonstrated to your customer a saving of 40 per cent.; the customer then pays his $2 each for the burners and is happy. In the course of a month or two lights begin to go down, the gas bill goes up, and then comes the clash and the customer gets the worst of it."

Another says "I am firmly of the opinion that the burner and the effort to establish it will be of short duration, and that its temporary adoption was due mostly to business depression and an effort to curtail expense. Mr. Butterworth, president of the Ohio Gas Association, in March said the gas companies had quite a falling off in gross receipts due to bright weather, depression in business and electric light."

Another says, "We own the electric and gas works. We have tried the Welsbach burner but do not find our customers anxious to continue its use. The people desire simplicity and will not bother with the Welsbach. We have six or seven burners in use, all others having been ordered out by users."

Another says, "There are some Welsbach burners in use here, less now than four years ago. There were about twelve here four years ago and the people discarded most all of them."

It appears that this burner is used mostly by gas companies in their struggle to keep above water, as it were. They enter into a combat that will probably end in mutual disaster, hoping, thereby to enter into a combination that shall jointly serve the twin interest. In such instances it would seem politic for electric companies, where they have no desire to combine, not to consider the competition of such burners as permanent, and the best plan of meeting it satisfactorily is to discard incandescent lighting by low efficiency lamps and in lieu use lamps of high efficiency and, best of all, the subdivided arc ranging in candle power from 700 to 1,000 candle power, which is being succesfully used in alternating current systems. In the larger cities such as Boston, Pittsburgh and Baltimore, the 900-cp. lamp has wiped out the high candle power gas burners.

The Best Way of Saying It.

Our contemporary, the London *Electrician*, makes the suggestion that "technical journals when they have nothing to say might be well excused if they refrain from saying it."

Resonance.

Mr. C. P. Steinmetz, in the discussion on the paper of Dr. Pupin, read before the Philadelphia meeting of the American Institute of Electrical Engineers, and printed in the November numner or tne *Transactions*, claimed that resonance was merely a special case of a well known phenomenon. He recalled the fact that if in an alternating circuit a self-induction is inserted, the self-induction will consume an E. M. F. lagging behind the impressed E. M. F. by 90 degrees, or a quarter period. The resistance will consume an E. M. F. in oppositon to the impressed E. M. F.; and a condenser in serted in the circuit will take a current leading 90 degrees.

Next is considered what takes place if there is a circuit closed by a condenser, that is a circuit whose current leads the E. M. F. by 90 degrees or a quarter period, and having in series with the condenser a self-inductance. By self-induction a counter E. M. F. is induced which lags 90 degrees behind the current. But the current is 90 degrees ahead of the impressed E. M. F. Thus, the counter E. M. F. of self-induction is in phase with the impressed E. M. F. and adds itself thereto. Hence, the effective E. M. F. is increased by the self-induction being brought into phase with the impressed E. M. F., and if this increase is excessive, it is called "resonance," but it is nothing different from the action of the choking coil, which produces a counter E. M. F., 90 degrees behind the current, and thereby, according to the phase relation between current and impressed E. M. F., either reduces the E. M. F. if the current is lagging, or increases the E. M. F. if the current is leading.

Thus, if suppose we have a condenser with an impressed E. M. F. of say 100 volts, and taking 10 amperes with a self induction in series which with 10 amperes current will produce a counter E. M. F. of 100 volts; this counter E. M. F. of 100 volts is now due to the lead of the current, in phase with the impressed 100 volts, adds itself thereto and thus gives 200 volts t the condenser terminals, with 100 volts impressed at the generator. These 200 volts will double the current and you get 20 amperes through. These 20 amperes will induce a counter E. M. F. of self induction of 200 volts. Then you get 400 volts at the condenser terminals. That means 40 amperes and 400 volts at the self-induction. So it is seen that the self induction in series will raise the condenser E. M. F. infinitely, that is, until the increase of the current causes the resistance to consume the total impressed E. M. F. It is therefore claimed by Mr. Steinmetz that resonance is nothing but our well known old friend self induction introducing an E. M. F. lagging 90 degrees behind the current and thereby affecting the impressed E. M. F. according to the phase relation of the current.

Hysteresis.

In the discussion on the papers of Dr. Pupin and Mr. C. P. Steinmetz, read before the Philadelphia meeting of the American Institute of Electrical Engineers, and printed in the November number of the *Transactions*, Mr. Steinmetz refers to the misconceptions in regard to the definition of hysteresis. He states that molecular magnetic friction is *not* identical with hysteresis, and defines magnetic hysteresis as the disproportionality between the magneto-motive force and magnetism, as the name signifies, which disproportionality is produced if upon an alternating magnetic circuit no energy is expended; since energy is consumed in the circuit by the molecular magnetic friction, this energy must be supplied from somewhere, and, in the absence of any other source of energy, is supplied by the magnetomotive force in the form of magnetic hysteresis. But this energy may be supplied by mechanical energy, and this is the case in smooth core machines, and then we may not find any hysteresis, or any disproportionality between magnetic field strength and magnetomotive force.

In a transformer the iron core is indeed set in vibration by the alternating magnetism, but this vibration, Mr. Steinmetz states, cannot supply the energy consumed by molecular friction and thus cannot eliminate magnetomotive force, and has the effect of intensifying the loss of energy—increasing the area of the hysteretic loop by the loss of energy in mechanical vibration, thus intensifying the higher harmonics, since now energy is expended not only by molecular magnetic friction, but also by mechanical vibration.

In another place Mr. Steinmetz states in regard to the loss of energy by magnetic friction in a rotary magnetic field, as for instance in the revolving armature of a bipolar smooth core dynamo, that he found no essential difference than with the loss in an alternating field, but that occasionally the observed core loss in the armature of a machine is not the molecular magnetic friction only, but superimposed upon it are eddy current losses in the iron, the shields, etc., and in the conductors, which losses are proportional to the square of the magnetization. Thus, the observed core loss sometimes rises with a power higher than 1.6, sometimes nearly approaching the square. But by laminating the iron very carefully, designing the mechanical construction so as to expose no solid metal to the alternating field, and shaping the conductors so as to exclude eddy currents, he always got curves very nearly proportional to the 1.6 power, up to very high magnetic densities (abo. $\mathcal{B} = 19,000$). He thinks the law holds for generators just the same, and therefore believes the law applies. not to the hysteresis loss, but to the loss by molecular magnetic friction, since in the generators we probably have no hysteresis. Mr. Steinmetz states he took pains once to find out if there is a lag of the magnetism behind the resultant megnetizing force in a generator which would distort the wave of electromotive force, but did not find anything of the kind. Thus the total loss of energy, which may be many kilowatts, may be supplied directly by the mechanical power, in which way he was not able to say, but not in the form of a hysteretic loop, at least not a hysteretic loop of noticeable size.

In reply to Dr. Pupin Mr. Steinmetz stated that hysteresis has a well defined meaning. It was introduced merely to denote the lag of the magnetism behind the magnetomotive force, as the derivation of the word signifies, which lag causes the magnetism as a function of an alternating M. M. F. to describe a closed curve, the "loop of hysteresis." Afterward it was shown by Warburg and Ewing that the area of the hysteretic loop represents energy, and represents the energy expended by the magnetomotive force during the cycle of magnetism, and from this the erroneous conclusion has been drawn that this hysteretic energy is the energy lost in the iron by molecular magnetic friction, that is, by changing the mangetic state of the iron. Mr. Steinmetz asserts that this conclusion is wrong; that this energy expended by the magnetomotive force is not necessarily the energy wasted in the iron. The energy represented by the hysteretic loop or a part of it may be converted into mechanical motion, or the energy lost in molecular magnetic friction may be supplied by mechanical energy, and the hysteretic loop may collapse, or may expand considerably, so that between the area of the hysteretic loop and the loss of energy in the iron there is no direct relation.

Sine Form of Curves of Alternating E. M. F.*

BY C. F. SCOTT.

Seven years ago I was engaged in the testing of some motors, the first motors of the Tesla type, by the way, which were used for commercial work. I had gone over the designs and had tested some preliminary experimental motors and thought I had everything covered with regard to the construction of the motors. A number had been made and in the test of the first one the motor had been carrying its load for an hour or more when I found an unduly high temperature. I found the speed had fallen from synchronism fully fifty per cent. more than it should have fallen and the motor, instead of coming up to a definite temperature, kept going up on what was a rather straight line. I had a second generator started and transferred the motor from the generator that had been running to the new one. The speed immediately came to what it should be and the temperature began to fall, although the load was the same. The heating of the motor with one generator was equivalent to what would have been obtained by carrying half or two-thirds additional load with the second generator. The second generator, the good one, gave a curve which was approximately a sine-curve. The first generator gave a wave form which was measured and found to be very much depressed at the middle, where the sine-curve is maximum, showing that the third harmonie was very strongly present.

An analysis of the effect of the third harmonic in the rotating field shows some rather interesting relations. The third harmonic evidently tends to a synchronous speed which is three times as great as the fundamental, so that if we have present a third harmonic we are tending of course to two speeds of rotation, the speed of the fundamental and another three times as fast. This third harmonic, however, is negative in its tendency to rotation. That is,

*From discussion on Dr. Duncan's paper on "Experiments with Two-Phase Motors," printed in November number of *Transactions* of the American Institute of Electrical Engineers.

the fundamental produces rotation in one direction and the third harmonic not only tends to produce a different speed, but it is in the opposite direction. This can be very simply shown by drawing a sine-wave and its third harmonic, and also a second wave which is a quarter-phase from the first, together with its harmonic. You will notice that if the first fundamental comes before the second one, that the third harmonic of the first comes after that of the second one. Consequently the fundamentals tend to rotation one way, and the third harmonics in the opposite direction. By different relative values of the two we may get almost anything. We may get normal rotation or no rotation at all, or rotation at normal speed in the opposite direction, or twice normal speed or three times normal speed.

Practical Notes on Dynamo Calculation—XIX.

BY ALFRED E. WIENER.

(*b*) *Bore of Pole-Pieces.*

The diameter of the pole pieces, or the bore of the field, d_p, i given by the diameter of the armature core, the height of the armature-winding, and the clearance between the armature-winding and the pole-pieces:

$$d_p = d_a + 2 \times (h_a + k_{12}); \ldots\ldots\ldots\ldots (104)$$

d_a = diameter of armature core, in inches;

h_a = Height of winding-space, including insulations and binding-wires, in inches;

k_{12} = Clearance between external surface of finished armature and polepieces, in inches. See Table XLVIII.

The latter dimension, which is to be taken as small as possible, in order to keep the air-gap reluctance at a minimum, ranges between 1-32 and 7-16 inch, according to the kind of the armature and its size. The following Table XLVIII, may serve as a guide in fixing its limits for any particular case:

TABLE XLVIII.—RADIAL CLEARANCE FOR VARIOUS KINDS AND SIZES OF ARMATURES.

RADIAL CLEARANCE, k_{12}, IN INCHES.

Diameter of Armature, in Inches.	Smooth Armature.					Toothed and Perforated Armature.
	Disc or Ribbon Core.			Wire Core.		
	Wire Wound.		Copper Bars.	Wire Wound.	Copper Bars.	
	Drum.	Ring.				
Up to 2	$\frac{1}{32}$	..	..	$\frac{3}{64}$	..	$\frac{1}{32}$
" 4	$\frac{3}{64}$	$\frac{1}{32}$	..	$\frac{1}{16}$	..	$\frac{1}{32}$
" 8	$\frac{1}{16}$	$\frac{3}{64}$	..	$\frac{3}{32}$	..	$\frac{3}{64}$
" 12	$\frac{3}{32}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{3}{64}$
" 18	$\frac{1}{8}$	$\frac{3}{32}$	$\frac{5}{64}$	$\frac{5}{32}$	$\frac{3}{32}$	$\frac{1}{16}$
" 24	$\frac{5}{32}$	$\frac{1}{8}$	$\frac{3}{32}$	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{5}{64}$
" 30	$\frac{3}{16}$	$\frac{5}{32}$	$\frac{1}{8}$	$\frac{7}{32}$	$\frac{5}{32}$	$\frac{3}{32}$
" 40	..	$\frac{3}{16}$	$\frac{5}{32}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{1}{8}$
" 50	..	$\frac{7}{32}$	$\frac{3}{16}$	$\frac{9}{32}$	$\frac{7}{32}$	$\frac{5}{32}$
" 75	..	$\frac{1}{4}$	$\frac{7}{32}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{16}$
" 100	..	$\frac{9}{32}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{7}{32}$
" 125	..	$\frac{5}{16}$	$\frac{9}{32}$	..	..	$\frac{1}{4}$
" 150	..	$\frac{3}{8}$	$\frac{5}{16}$	..	..	$\frac{9}{32}$
" 200	..	$\frac{7}{16}$	$\frac{3}{8}$	..	..	$\frac{5}{16}$

The above table shows that with toothed and perforated armatures the smallest clearance can be used, a fact which is explained by the consideration that the exteriors of these armatures offer a solid body, and may be turned off true to the field-bore. From a similar reason wire-core armatures need a larger clearance than disc-core armatures, since the former cannot be tooled in the lathe, and have to be used in the more or less oval form in which they come from the press. Since copper-bars can be put upon the body with greater precision than wires, a somewhat larger clearance is to be allowed in the latter case. Finally, a drum armature, in general, has a higher winding space than a ring-armature of same size, the unevenness in winding will, consequently, be more prominent in the former case, and therefore a drum armature should be provided with a somewhat larger clearance than a ring of equal diameter.

The figures given in Table XLVIII may be considered as average values, and, in specially favorable cases, may be reduced, while under certain unfavorable conditions an increase of the clearance may be advisable.

(*c*)—*Polar Embrace.*

The dimensions of the magnetic field having thus been determined, half the pole-space angle, α, Fig. 47, can be found from the trigonometrical equation:

$$\sin \alpha = \frac{e_p}{d_p}; \ldots\ldots\ldots\ldots (105)$$

e_p = pole-distance, in inches, from formula (103);

d_p = diameter of polepieces, in inches, from formula (104);

The ratio of polar embrace, or the percentage of polar arc, then, is:

$$\beta = \frac{90^\circ - \alpha \times P}{90^\circ}, \ldots\ldots\ldots\ldots (106)$$

in which α = half polespace angle, from (105);

P = Number of pairs of magnet poles.

From (106) follows, by transposition:

$$\alpha = \frac{90 \times (1 - \beta)}{P}, \ldots\ldots\ldots\ldots (107)$$

from which the pole-space angle, α, can be calculated in the case that the ratio of embrace, β, of the pole-pieces is given.

35.—*Relative Efficiency of Magnetic Field.*

The useful flux of the dynamo being found from formula (91), the number of lines of force per watt of output, at unit conductor-velocity, will be a measure for the magnetic qualities of the machine, and may be regarded as the *relative efficiency of the magnetic field.*

The field-efficiency for any dynamo can accordingly be obtained from the equation:

$$\zeta = \frac{\Phi}{E \times C} \times S = \frac{\Phi}{W} \times S, \ldots\ldots\ldots\ldots (108)$$

where

ζ = Relative efficiency of magnetic field, in webers per watt of output at a conductor-velocity of 1 foot per second.

Φ = Useful flux of dynamo; from formula (91) or (92).

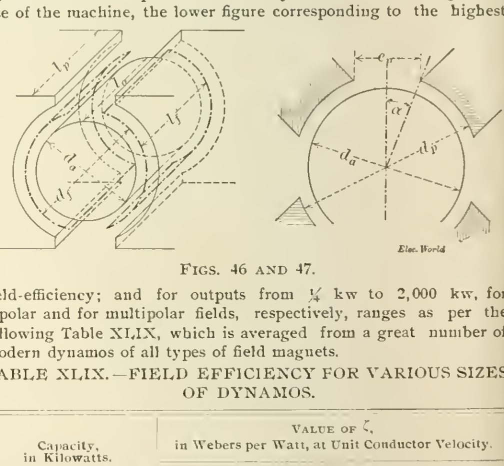
E = Total E. M. F. to be generated in machine, in volts.

C = Total current to be generated in machine, in amps.

$W = E \times C$ = Total output of machine in watts;

S = Conductor-velocity, in feet per second.

The numerical value of this constant, ζ, varies between 4,000 and 40,000 lines of force per watt at 1 foot per second, according to the size of the machine, the lower figure corresponding to the highest



Figs. 46 and 47.

field-efficiency; and for outputs from ¼ kw to 2,000 kw, for bipolar and for multipolar fields, respectively, ranges as per the following Table XLIX, which is averaged from a great number of modern dynamos of all types of field magnets.

TABLE XLIX.—FIELD EFFICIENCY FOR VARIOUS SIZES OF DYNAMOS.

Capacity, in Kilowatts.	Value of ζ, in Webers per Watt, at Unit Conductor Velocity.	
	Bipolar Fields.	Multipolar Fields.
Up to .25	15,000 to 40,000	....
.25 to 1	10,000 to 20,000	....
1 to 10	8,000 to 15,000	10,000 to 20 000
10 to 50	7,000 to 12,000	8,000 to 15,000
50 to 100	6,000 to 10,000	7,000 to 12,000
100 to 500	5,000 to 7,500	6,000 to 10,000
500 to 1,000	....	5,000 to 7,500
1,000 to 2,000	....	4,000 to 6,000

For a newly designed machine, the value ζ obtained by means of formula (108) will be within the limits given in this table, provided the armature has been calculated in accordance with the rules and tables furnished in the respective chapters of Part I.

As from Table XLIX follows the self-evident fact that the magnetic fields of large dynamos are more efficient than those of small ones, a curve was plotted in order to examine the rate of this increase. For this purpose the useful fluxes of all the dynamos considered were reduced to the basis of a conductor velocity of 50 feet per second, when the heavy curve, Fig. 48, was obtained by averaging the values of the flux thus found:

From this curve a law can be deduced for the increase of the field efficiency with increasing size. In the following Table L, from the average useful flux for 50 feet conductor velocity, as plotted in Fig. 48, the specific flux per kilowatt has been calculated, showing the rate of increase of the field-efficiency:

TABLE L.—VARIATION OF FIELD-EFFICIENCY WITH OUTPUT OF DYNAMO.

Capacity, in Kilowatts.	Total Average Useful Flux, at Velocity of 50 feet per Second.	Specific Flux, Webers per Kilowatt, at 50 feet per Second.
.1	100,000	1,000,000
.25	200,000	800,000
.5	350,000	700,000
1	600,000	600,000
2.5	1,300,000	520,000
5	2,300,000	460,000
10	4,000,000	400,000
25	8,500,000	340,000
50	15,500,000	310,000
75	22,000,000	294,000
100	28,000,000	280,000
200	50,000,000	250,000
300	70,000,000	233,000
400	88,000,000	220,000
500	104,000,000	208,000
600	118,000,000	197,000
700	130,000,000	186,000
800	141,000,000	176,000
900	151,000,000	168,000
1,000	160,000,000	160,000
1,200	175,000,000	146,000
1,500	195,000,000	130,000
2,000	220,000,000	110,000

By the law of inverse proportionality between useful flux and conductor-velocity, the remaining curves for 25, 30, 40, 60, 75 and 100 feet per second, respectively, were then drawn in Fig. 48.

Tabulating all the values thus received we obtain the following

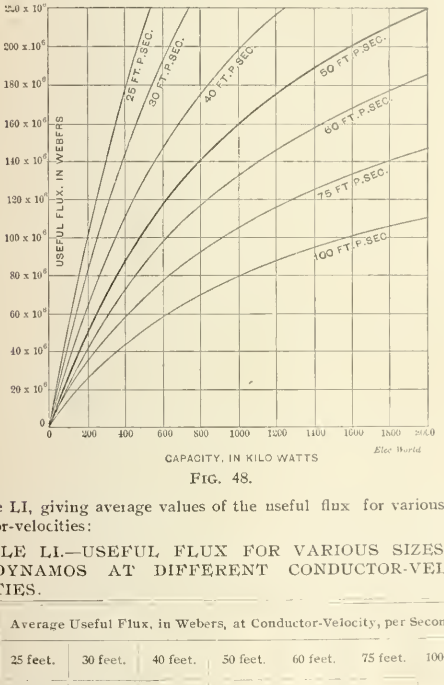


FIG. 48.

Table LI, giving average values of the useful flux for various conductor-velocities:

TABLE LI.—USEFUL FLUX FOR VARIOUS SIZES OF DYNAMOS AT DIFFERENT CONDUCTOR-VELOCITIES.

Capacity in Kilowatts.	Average Useful Flux, in Webers, at Conductor-Velocity, per Second, of						
	25 feet.	30 feet.	40 feet.	50 feet.	60 feet.	75 feet.	100 feet.
.1	200,000	167,000	125,000	100.000	83,000	....	....
.25	400,000	333,000	250,000	200,000	167,000	....	...
.5	700,000	583,000	438,000	350,000	292,000	....	....
1	1,200,000	1,000,000	750 000	600.000	500.000	400,000	....
2.5	2,600,000	2.200,000	1,600 000	1,300,000	1,100 000	870.000	....
5	4,600,000	3.800.000	2,900,000	2.300 000	1 900,000	1,500.000	....
10	8,000,000	6,700,000	5.000,000	4.000,000	3,300,000	2,700,000	....
25	17,000,000	14,200,000	10,600,000	8,500,000	7.100.000	5,700.000	....
50	31,000,000	25,800,000	19.400,000	15,500,000	12,900,000	10.300.000	....
75	44,000,000	36,700,000	27,500,000	22 000.000	18,300,000	14.700.000	11,000,000
100	56,000,000	46,700.000	35,000,000	28.000,000	23.300.000	18,700,000	14,000,000
200	100,000,000	83,300,000	62,500.000	50.000,000	41,700.000	33,300 000	25,000,000
300	140,000,000	117,000,000	87.500,000	70,000.000	58,300.000	46,700.000	35.000.000
400	....	147,000,000	110,000,000	88,000,000	73,300,000	58,700,000	44,000,000
500	....	173,000 000	130,000.000	104.000,000	86,700,000	68,300,000	52,000,000
600	....	197,000,000	148,000,000	118.000,000	98,300,000	78,700,000	59.000,000
700	....	216,000,000	163,000,000	130,000.000	108,000,000	86,700,000	65.000,000
800	....	235,000,000	176.000,000	141.000,000	117,000 000	94,000,000	70,500,000
900	...	...	189,000,000	151,000,000	126 000,000	101.000,000	75,500,000
1,000	....	....	200.000,000	160,000 000	133 000,000	107 000,000	80 000.000
1,200	....	....	219,000.000	175,000,000	146,000.000	117,000.000	87,500,000
1,500	....	....	244,000 000	195 000,000	163 000.000	130,000,000	97.500.000
2,000	....	....	275,000,000	220,000,000	183,000,000	147,000,000	110,000,000

(To be continued).

Notes on the Management of Railway Power Stations—VIII.

BY GEORGE T. HANCHETT.

The Car Equipment (Mechanical).

The mechanical design of the average street car truck is one of the few things in motive street railway construction that has taken a step backward. There are very few of the street car trucks now offered to the street railway officials that are properly designed. The designer of the crudest wagons first fastened an axle securely to the flooring. That was found to hammer and jolt considerably even on the smoothest road. Then came the spring seat. This added to the comfort of the person riding in the wagon, but had no mercy on the other load of the wagon or the road over which it was travelling. The need of springs on the axles was felt and supplied, and lastly, wherever feasible, the pneumatic tire has been adopted, where ease of riding is the main object. The vehicle became more and more easy on both road, and wider as the spring suspension approached the point of contact with the earth. Plainly as this lesson has been taught, the truck designers have signally failed to reduce the hammer blow by this simple expedient.

This will perhaps be plainer by an even simpler illustration. If a hammer be constructed, as *A* in Fig. 23, with a thin plate of steel suspended by a spiral spring as shown, it does not require an engineer to see that the driving of a nail, or, in short, striking a

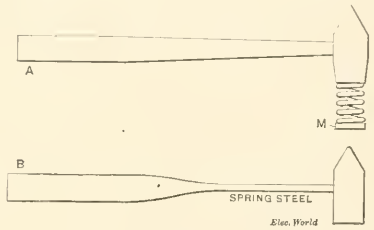


FIG. 23.

heavy blow, would be extremely difficult. In direct proportion as we increase the mass of the piece, *M*, the blow becomes heavier and heavier till at least as the spring recedes from the face of the hammer we approach the hammer, *B*, in which a spring handle is used. With this hammer a tremendous blow can be struck, heavier even than if there were no spring in its construction at all.

This design is what is usually followed in the average street car truck. The first thing the designer does is to fasten rigidly to the axle boxes of the truck a heavy frame on which is mounted the motor, often rigidly also. This forms the heavy hammer head. To provide for the comfort of the passengers the next step is to furnish a powerful spring handle in the shape of a row of elliptic, spiral, or leaf springs between the car body and the truck proper. The car body forms a tireless arm of great power to manipulate the device. A better all-around scheme to ruin tracks could not be designed.

In order to reduce the hammer blow on the joints, place the spring suspension as near the point of contract with the earth as possible. It is practically impossible to excel pneumatic tires on smooth surfaces for ease of riding. A machine with spring spokes, if such were possible, would be next in value in this regard. It is then obvious that the spring suspension of a railway truck should be on the axle box. This is the farthest that present practice can carry out the principle here set forth. The hammer blow was never a problem with steam roads for the simple reason that even the poorest trucks were designed with the springs as near as practicable to the axle-boxes. There is a truck used under a freight car which in its design is vastly superior to the average modern street cab truck, simply because the springs are on the axle-boxes. The difficulty of building a low truck with the springs placed in this manner has largely contributed to the resulting incorrect designs. The station manager usually approves the truck and should look for these points when his opinion is asked.

Light trucks and motors are of evident value and are widely appreciated. This is only another means of approaching the same end. Returning to our hammer illustration we see that this simply diminishes the mass of the piece "A."

If we look over the usual instructions for the installation of an electric motor we invariably find "The motor should be located in a cool, dry room, free from dust or flying particles of any sort." Between the wheels of a street-car truck is then as nearly the oppo-

site of this requirement as one can well imagine. Not one of the above conditions is satisfied. In view of this the motor should have exceptionally good care. This can only be given by frequent and careful inspection. The dynamo and engine in the power-house are carefully watched and oiled. They are well located and have every advantage. On the same principle the street car motor needs much more care, due to its unfavorable location.

At the end of every trip it should be run over the pit. Loose nuts, hot boxes, burnt commutator bars, and matters of a kindred nature, should be carefully sought for. Dust or mud should not be allowed to accumulate. Designers have produced motors that are admirable for resisting dust and moisture, but that should be no excuse for allowing the latter to accumulate any more than an efficient safety stop is an excuse for the use of a fly wheel of weak and unreliable material. The screws of the motor support should receive minute inspection. Every screw on the truck is liable to be jarred loose and the dropping of the motor into the street is almost certain to wreck the greater part of the equipment, both mechanically and electrically. Do not be satisfied with simple, rapid inspection. Open the motor box. For an experienced man, with the tools at hand, it is but the work of a moment. It is almost impossible for foreign matter to lodge there with modern enclosed motors, but it is equally impossible for the obstacle to find an exit. The chances are that whatever does succeed in getting in is there to stay, unless it is removed.

Washers, carbon dust, bits of gravel, sand, pieces of carbon brushes, and other matter capable of doing serious damage, have been found in the motor cases of some of the best types. The inspector should thoroughly understand the motor and all its parts. The time for inspection is usually brief, but everything must be noted. Spare parts should be at hand and no armature or field coil in which a defect is suspected to exist should be allowed to go on a trip. In no case is the old adage of a "stitch in time" truer than in the case of the railway motor.

It is not wise to change the motormen about promiscuously. Have each motorman with a regular motor under his charge and hold him responsible. Motormen frequently race their motors to the limit, stop with a jerk and start up again at break-neck speed. When they approach the car barn they are careful to proceed slowly for the double reason of appearing exactly on time with a cool motor. By placing a bit of paste board with paraffine wax at a carefully determined distance from the bearings on the interior of the motor case, the culprit may be detected and deserved reprimand administered. It is obvious that the proper position for this pasteboard is nearer the bearing in winter than in summer.

Above all, a record of every inspection should be made. By this means the cause of an accident can in nine times out of ten be determined, and it is only by a thorough knowledge of causes that we shall be able to control results.

In running the car remember that the motor is hung very near the ground and that it does not require much of a stone to be an obstacle. Run carefully over curves, crossings and switches and thus save both them and the motors. With a little practice the motorman can accustom himself to the ordinary sights, sounds and smells on and about a car equipment and anything unusual will at once be detected.

The one thing that is most liable to derange the mechanical portion of a car equipment is vibration. This is largely met by a properly designed truck, but a careful motorman can also do much to reduce this evil.

The car should be provided with a monkey wrench, a few duplicates of the most important bolts and nuts, a pair of plyers, some rubber tape and a supply of insulated copper wire about No. 8 B. & S. With these simple tools and materials vexatious delays can often be avoided.

The motorman should be present when his motor is taken apart and inspected. By this means he will become familiar with the various parts and their diseases. The motor is under his care the greater part of the time and therefore the more he knows of its construction the fewer accidents there will be. A green motorman is one of the most expensive things a general manager has to contend with. If an increase of pay is held out to the men as the number of accidents that they meet with becomes smaller and those that they do meet with are successfully met, the result will be a crew of men that will save not only the machines but will also save the company from suits for damages to property and life. If the men are given to understand that the increase that they earn by care is subject to forfeiture by subsequent carelessness, this will be an additional incentive.

(To be continued.)

Relation Between Line Wire Losses and the Over-Compounding of Dynamos.

To the Editor of The Electrical World:

Sir: In The Electrical World of October 13th., Prof. E. P. Roberts published an article on the "Relation between Line Wire Losses and the Over Compounding of Dynamos," in which he points out certain difficulties that may arise when over-compounded generators are run in parallel. He discusses several cases and in regard to case 2, states that "this method is correct in principle" and that case 3, "also is theoretically correct." The rest of the article is entirely devoted to showing how serious the trouble may be. It occurred to me while reading the article that it would be likely to be misunderstood and that the reader might think the difficulty almost insurmountable or only "theoretically" avoidable. This idea has since been borne out by the fact that a prominent magazine has referred to the article in this way. As a matter of fact, the remedy is perfectly simple and entirely effective.

In the little book on "Practical Management of Dynamos and Motors" by Dr. S. S. Wheeler and the writer, the remedy for this trouble is given (1st. Edit. 1892, page 28; 2d. Edit. 1894, page 56). This consists in leaving the "equalizer" permanently connected in all the machines so that the series coils are always in circuit in parallel which "has the effect of compounding the dynamos collectively instead of individually" and "makes the effect of the series coil proportional to the total load instead of the load on each machine." This method is identical with case 3, of Prof. Roberts which he merely states to be "theoretically correct" without explaining it or saying whether it is practically operative and satisfactory.

The only objection to this method is that it requires the series coil of every dynamo to be in circuit whether the machine is working or not, and in the cases of high tension machines it would be particularly undesirable to have them "alive" (*i. e.* connected to the circuit) while they were being cleaned. This difficulty can easily be overcome, however, by substituting for the series coil of a given machine a coil having the same resistance and current capacity. This substitution enables the series coil to be taken out of the circuit and the whole machine may thus be disconnected from the others when it is not working, at the same time securing the proper compounding effect.

There is still another important point besides the one discussed by Prof. Roberts and it is due to the same causes. This is the fact that the series coil of a dynamo should be connected to the equalizer *before* the armature of the machine is connected to the circuit in parallel with other generators. If on the other hand, the voltage of the machine is made to agree with that of the circuit, the field magnet being excited by the shunt coils only, then its E. M. F. will suddenly rise when the machine is connected to the circuit and the current flows through its series coil. This will cause the machine to take a large load instantly, instead of having it gradually applied by adjusting the rheostat in the shunt field circuit. Thus it will be seen that both these troubles that may arise in connecting compound dynamos in parallel, are avoided by having the series coils permanently connected through the equalizer.

Columbia College, New York. F. B. CROCKER.

Signalling Through Space.

To the Editor of The Electrical World:

Sir:—In your issue of November 17, Mr. Thos. D. Lockwood refers to my note of the previous issue relative to an instance of telephonic induction from a telegraph line to a short telephone line through the medium of a second telegraph line at right angles to the first. He regards as more probable that conduction existed between the two telegraph lines due to breakage across supports, etc.

I had purposely disregarded this view of the matter because the climatic conditions were much more favorable to inductive effects than to any breakage existing over or across supports, etc. My original views of the matter were further strengthened because of the fact that I could plainly hear the humming of street car motors in Harrisburg, as they gradually absorbed more power from the trolley wire, and again as it was decreased, thus producing a varying electrostatic field in the vicinity of the telegraph line. Of course, the field in this case is a very strong one, but the principle remains the same; and I only adhere to the inductive effect between the telegraph lines because of the fact that the atmosphere on that particular day was very clear and dry, rendering conduction the least probable of the two.

Pittsburgh, Pa. E. A. GRISSINGER.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

Note.—Owing to the frequent delays in the transatlantic mails during the winter months, abstracts and references of some of the foreign journals, chiefly the more important ones from England and Germany, cannot be published as promptly as heretofore.

ELECTRO-PHYSICS.

Volta's Fundamental Experiment.—In a lecture briefly abstracted in the "Zeit. feur Elek." Nov. 1, the following experiments by Prof. Stricker are described. It was shown that the generation of electricity by a pair of plates took place not only when they are separated after having been in contact, the way in which the experiment is usually shown, but also when they are brought near to each other and then suddenly separated; actual contact is therefore not necessary; that the layer of air serves as an insulator and not as a moist substance, is shown by the fact that if it had acted in the latter capacity, the zinc pole would have to be negative, but in this experiment it is positive, whether the plates have touched each other or not. That contact is not necessary he also showed as follows: If, instead of separating the plates, they are suddenly approached, electricity will be generated as before but with opposite signs. The experiment was then made to show the potential of a metal in a liquid by connecting the liquid with the earth by means of a wet string; in this way zinc in zinc sulphate was negative and copper in copper sulphate was positive. These and other experiments were shown to illustrate the theory of Stricker that currents of different signs pass through a circuit from both poles, each one passing with a gradual decrease of its energy; the two currents are added when they flow in opposite directions from the same conductor; if a single branch connection is made, only the difference between the two currents will pass through it; a negative current is also shown to have a much greater action on the muscles than a positive current.

Refraction and Dispersion of Rays of Electric Force.—A paper by Messrs. Garbasso & Aschkinass, from the "Wied. Ann.," No. 11, 1894, is published in the Lond. "Elec.," Nov. 9. They show that the rays proceeding from a Hertzian primary conductor may be analyzed into a spectrum by a prism made up of resonators, and from this they draw the two deductions: (a) The emitted rays of electric force may be regarded from a physical point of view, not necessarily as monochromatic, but as composite with about the same degree of justification as white light; (b) Helmholtz's theory of chromatic dispersion gains further support by their results. Editorially it is claimed that it is not certain that their first conclusion is really proved by their researches and that the waves emitted by the oscillator are not shown to be compounded like the waves of white light.

Propagation of Light.—An article from the "Wied. Ann.," vol. 50, page 361 (1893) by Mr. Reiff, is reprinted in "L'Eclairage Elec.," Oct. 27, the title being "The Propagation of Light Through Mediums According to the Electromagnetic Theory of Light;" it is mathematical in character.

MAGNETISM.

Magnetic Properties of Asbestos.—The subject is further discussed by Mr. Bleekrode in the Lond. "Elec. Rev.," Nov. 9. He states that Brugman discovered this quality of asbestos as early as 1778, and that Faraday also pronounced asbestos a feebly magnetic substance. He describes experiments made by himself, showing that asbestos, and especially in the form of mill-board, could be raised some distance by a magnet, that it acquired magnetic polarity after having been in contact with a magnet, and that when in contact with one pole of a magnet the other end of the asbestos would attract iron filings. Electric attraction he says has nothing to do with these effects; he differs from Mr. Swinton, who ascribes the magnetic quality to the presence of iron, as iron compounds are only feebly magnetic and that even the sesquioxide of iron, although composed of two strong magnetic substances is apparently neutral in comparison with asbestos; he suggests that some magnetic substance may perhaps be introduced in the manufacture of asbestos cardboard. Mr. Hancock, in a letter published in the same issue, endeavors to explain that asbestos is not magnetic.

Magnetarium.—A brief description of this globe made to imitate the earth as a magnet (see Digest, April 7) is published in the Lond. "Elec. Rev.," Nov. 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standards of Measurments.—In the Lond. "Elec. Rev.," Nov. 9, Lord Kelvin replies to a recent statement made in that journal regarding the possible effect of vibrations on the ligaments of his electro-dynamic balance used in the Board of Trade Laboratory; he states that no such effect could be produced unless the vibration of the table was "much more than enough to cause the ink to jump out of an ink bottle placed beside it on the same table." He describes how the ligament is aged by a severe process by the maker, with weights of 4 to 56 lbs. kept on for 2½ days; in some cases a slight stretching has been found after long continued heating by an electric current; the sights at the two ends of the beam makes it impossible that any elongation could pass unperceived and means are provided for readjustment.

Measuring the Armature Loss and Efficiciency of Motors and Generators.—The "Elek. Zeit.," Nov. 1, contains a long article of a practical nature by Mr. Grau, in which he shows how the total losses in the armature and the efficiency of the whole machine may be determined by a purely electrical process (although not a very simple one). Each of the five different losses in the armature are determined separately; for the hysteresis loss (in watts) in a two-pole machine he gives the formula

$$0.002\, \mathfrak{B}^{1.6}\, V \frac{n}{6 \times 10^8}$$

in which $\mathfrak{B}$ is the magnetic induction in the armature, V its volume in cubic centimeters and n the number of revolutions per minute; the loss due to bearing friction is determined experimentally; the loss due to the short-circuiting of the armature coils by the brushes (presumably in watts) may be calculated by the formula

$$\frac{n\, L\, C^2}{60 \times 4}$$

in which n is the number of revolutions per minute, L the self-induction coefficient (in henrys) of the whole armature and C the current in amperes; the loss due to Foucault currents can be determined only approximately by the methods of Kapp, Hummel and Mordey; in the present article he shows how this latter loss may be determined accurately by the following method. The loss due to Foucault currents is, according to Clausius, for the same excitation, proportional to the square of the number of revolutions, or at a constant speed, to the square of the field strength, and represented by the formula (presumably in watts) cN^2 in which N is the total number of lines of force and c is a constant, the value of which he determines by the following method: (its value is extremely small, being in about the 10th and 11th decimal places). The dynamo to be measured is coupled directly to a motor, both being separately excited from an outside source; around the armature of the dynamo there is a single turn of wire which does not revolve, the ends of which are connected to a ballistic galvanometer; the self-induction was measured at the required speed and current (see previous paragraph); the power transmitted by the motor is then equal to the sum of all those losses added to the output of the dynamo; the excitation of the dynamo is then changed, but that of the motor, as also the speed, remain unchanged, the load on the dynamo being altered until the power delivered to the motor is (exactly) the same as in the first case, and therefore also that transmitted to the dynamo, and all the losses in the dynamo except that due to power friction, will therefore have different values; from the two simple equations giving the sum of these powers and losses the value of c above mentioned, may then be calculated, provided all the other quantities are known. He describes in detail a series of tests illustrating the method, including also a method for determining the bearing friction; it is very essential in determining c that the measurements be made very accurately and the speed and the power delivered to the motor be exactly the same (for instance, an error of less than 1 per cent. in the power delivered to the motor causes a difference of about 15 per cent. in the value of c in the particular problem given); all the losses being thus determined, the total efficiency may then readily be calculated. In practice it is required to determine the efficiency for different loads at constant excitation; in this case the test is carried out in the same way, both machines being separately excited, but the excitation in both is now kept constant; the number of lines of force in the motor is determined as before while running, by opening and closing the exciting current and measuring the induction with a ballistic galvanometer.

Photometric Units and Quantities.—In giving the symbols suggested by Hospitalier (see Digest, Nov. 10) the Lond. "Elec.," Nov. 9, says in regard to the appropriation of nonpareil heavy Gothic type for these units, "the country which has done by far the most work in modern 'magnetics' should by courtesy and by virtue of the good work accomplished be given a predominant voice in the choice of symbols."

Photometric Magnitudes and Units.—A translation of the paper by Prof. Blondel, abstracted in the Digest, Aug. 11, and referred to a

number of times since, is published by the London "Electrician" in pamphlet form, it being a reprint from that journal of Sept. 28, 1894.

Measuring the Degree of Incandescence of Lamps.—A few figures from Mr. Crova's paper (see Digest, Nov. 17) are published in the Lond. "Elec. Rev.," Nov. 9.

Measuring the Self-induction of a Dynamo Armature.—The Joubert method is briefly described by Mr. Grau in the "Elek. Zeit.," Nov. 1. If R is the resistance and L the self-induction coefficient of the armature, a known inductionless resistance r is connected in series with it and an alternating current C of the required strength is sent through it, and the difference of potential is measured at the ends of the resistance R and then at those of r; if these values are called E and e the following equation

$$C = \frac{E}{\sqrt{R^2 + w^2 L^2}} = \frac{e}{r}$$

will be true, from which the value of L is determined (w is apparently equal to 2π times the frequency).

Standard of Light.—The Lond. "Elec.," Nov. 9, publishes a translation in abstract of the paper by Messrs. Lummer & Kurlbaum, abstracted in the Digest, June 2 and Sept. 22.

New Standard of Light.—A lecture by Mr. Dibdin is briefly abstracted in the Lond. "Elec.," Nov. 9; it contains apparently nothing new.

Localizing Faults in Submarine Cables.—In accordance with the request of Prof. Jamiesen some students tried both of the methods mentioned by Mr. Jones and Prof. Jamiesen in the recent discussion (see in the late issues of the Digest), a cable tank and an artificial fault in the cable; the results are briefly stated in the Lond. "Elec. Rev.," Nov. 9. They found that about 50 per cent. more time was taken to connect up for Mr. Jones' method. than for the other, but the time for making the two tests was about the same; they state that there is no doubt that where earth or fault currents are present or where very high resistance slides cannot be obtained, the Jones' method is preferable; care should be taken that the condensers do not leak and in a comparative test the dielectrics of the condensers should be of the same material; the method described by Prof. Jamieson gave results about 2 per cent. nearer to the correct value; they prefer the null methods to that of discharges from a condenser.

Calorimetric Measurements.—In a Physical Society paper on the influence of temperature on the specific heat of aniline by Mr. Griffiths, published in the Lond. "Elec.," Nov. 9, he describes some delicate calorimetric measurements made with the aid of electrical apparatus.

Meter Testing.—The charges made by the London County Council for testing meters of various descriptions, are given in the Lond. "Elec. Eng.," Nov. 9.

Conductivity of Ethers.—A paper from the Italian by Mr. Bartoli, published in "L'Eclairage Elec.," Oct. 27, gives the results of observations on the influence of temperature on the electric conductivity of composite ethers.

DYNAMOS AND MOTORS.

Design of Large Alternators.—In the Lond. "Elec. Rev.," Nov. 9, Mr. Kennedy replies to the statements of Mr. Armstrong (see Digest, last week). His reply is briefly as follows: The statement that few machines are made without iron in the armature applies to America only, as in England this class of machine is made by the most important firms, and more of them are in use than any other type; no comparison can be made between costs on account of the protection in America; it is a great mistake to take cast iron as the material in solid field magnets, as it is used only for the framework, the best soft iron being always used for the cores and poles and he has not yet heard of laminated iron which can be used at a higher induction than good solid soft iron; in his country laminated field magnets cost at least double and often three times as much as those with soft iron cores; to compare laminations with cast iron is absurd; it should be compared with solid soft iron of the best quality or with the softest cast steel, which is not more than 10 per cent. below laminations in permeability and susceptibility; in discussing leakage it is not necessary to distinguish between armature and field magnets, and he asks where the leakage can occur in an ironclad field of the Mordey type, in which he has never been able to discover any, while in radial laminated poles he finds leakage from 25 to 50 per cent.; eddy currents exist in all dynamos and are not greater in a flat ring coreless armature than in the huge laminated structures in other machines; the English believe in great field strength and weak armature reaction; the primary object of the field coils is to produce the greatest induction through the generating coils, a fact which he says is often forgotten; regarding synchronizing he thinks one machine is as good as another, and he believes that the induction of the armature has nothing to do with the question, but if it has it is cheaper to obtain it by induction coils in the circuit; mechanical momentum has more to do with the question; any electrician ought to be able to synchronize any alternator whatever its construction may be; he denies that coreless armatures cannot be made sufficiently strong for all practical purposes, hundreds of them having been at work for ten years; coreless armatures and an ironclad field of the best soft steel can be made for just one-half the cost of a radial pole machine with laminated cores for the same output and speed, the coreless one weighing less; he believes that the exciter is really the weak spot in the alternator and is the cause of most of the trouble in synchronizing; he believes the coreless armature is the best and that the future will see all large continuous current machines made also with coreless armatures; laminations in large machines will become a thing of the past.

The same issue contains a long reply to Mr. Armstrong's letter by Mr. Raworth; it is chiefly personal in character and is in defense of the Mordey alternator. He says that the breaking of the field of an ironclad alternator need not throw it out of step; there are 350 Mordey machines in daily use, and he states that the sudden rush of current through the armature when the field current is broken has not taken place once in all of these; he denies that very close regulation of the field current is required, and states that not one of the Mordey alternators has ever yet dropped out of phase; alternators without iron outnumber other kinds manufactured in England two to one.

Ventilating Armatures.—A device by Mr. Poeschmann is described and illustrated in "L'Eclairage Elec.," Oct. 27; the pulley contains a fan ventilator which is connected by tubes leading through the bearing into the space around the armature and thence out at the commutator.

TRANSFORMERS.

Impedance of Transformers.—An editorial in the Lond. "Elec. Rev.," Nov. 9, calls attention to a paper by Mr. Rimington in "Proc. of the Phys. Soc." vol. 13, October, 1894. It contains the account of an investigation of the behavior of air-core transformers when the frequency is below a certain critical value; the investigation is a purely geometric one and demonstrates conclusively that under certain conditions the apparent impedance of the primary is not diminished on closing the secondary, as is usually supposed; among the cases discussed are that of an identical primary and secondary with magnetic leakage, that of two coils with different time constants without magnetic leakage and that of two coils with different time constants with magnetic leakage; presumably the reason why increased impedance on closing the secondary of ordinary transformers has not been noticed is because their lag angles are very large.

Principles of Transformer Design.—A series of articles by Mr. Alfred Still is begun in the Lond. "Elec.," Nov. 9; it is intended chiefly for students and will give a short, concise account of the principles underlying the design of transformers and choking coils; the present portion is somewhat elementary in character.

ARC AND INCANDESCENT LIGHTS.

Researches with the Electric Arc.—The first part of a paper read before the Austrian Academy of Sciences by Dr. Sahulka, is abtracted at some length in the "Zeit. feur Elek.," Nov. 1. It is known that between the positive electrode and the arc there is a large voltage and between the arc and the negative a small voltage, which is explained by the supposition that there are electromotive forces in the arc; with the alternating current these voltages are the same; to show that they are due to a counter electromotive force and not to a resistance, it is best to use an alternating current, as in that case these voltages can be measured apart from those due to resistance; it is also best to use two different materials for generating the arc; such an experiment will show that the arc in that case acts like a source of a continuous E. M. F. generating a continuous current; if the arc is formed between like horizontal electrodes, there will be no continuous current generated, but the arc will be negative as compared with either of the two electrodes; in a shunt circuit between the arc and one electrode a continuous current will flow; these results show that there is a true E. M. F. in the arc. He then describes in detail a series of measurements made with an alternating current arc between iron and carbon, a number of different measuring instruments being connected in series and in shunt by means of which the continuous current element and the alternating current element may be measured separately; these show that a continuous current flows through the alternating current circuit made up of the arc and the secondary of the transformer; the results of a number of measurements are given, from which it appears, among other things, that the continuous current was about half of the total current indicated by the electrodynamometer; also that the continuous E. M. F. generated by the arc was about 37.7 volts, the alternating voltage being about 75 volts. The generation of a continuous current might also be explained by the supposition that the resistances in the arc changes, as the iron and the copper will be vaporized alternately. The article is to be continued.

Alternating Arc Light Carbons.—An explanation of the fact that the consumption of the two carbons in the alternating arc is unequal, is given by Messrs. Bedell and Crehore in the Lond. "Elec.," Nov. 9; they explain it on the supposition that the energy in successive semi-periods is not equal.

Holophane Globes.—A general description, not including the theory, is given by Mr. Gilbert in "L'Eclairage Elec." Oct. 27; several illustrations, though not very good ones, are given; the globe is apparently the same one described in the Digest, Nov. 10.

Spectroscopic Comparison of Different Lights.—Some of the results

of Mr. Muetzel's paper, abstracted in the Digest, Sept. 22, are published in the Lond. "Elec. Rev.," Nov. 9.

ELECTRIC RAILWAYS.

Conduit System.—According to the "Elek. Anz.," Nov. 4, the Siemens & Halske Company have adopted the Lachmann system, in which there is a slotted conduit made up of sections, the top being formed like an inverted box, with the object of preventing any water in the conduit from extending into this box by virtue of the air in it; the conduit and even the street may therefore be immersed in water, but the air confined in this box will keep the water from reaching the wire which is supported therein. Trials made with this system are said to have been very successful; it is claimed that the cost will not be greater than that of the overhead trolley system, probably even less.

Electric Traction in Berlin.—The "Elek. Zeit.," Nov. 8, announces that the Municpal authorities of Berlin have decided to favor the transformation of horse traction in that city into electric traction, but whether the trolley system, the underground conduit or the accumulator system is to be used is not decided.

Light Railways.—A letter from the Board of Trade to various commercial bodies, discussing the introduction of light railways is published in the Lond. "Elec. Rev." Nov. 9. The Lond. "Elec." Nov. 9 publishes a long discussion of this letter; also a communication and a letter from the London "Times"

Electric Traction.—An Institution paper by Messrs. Blackwell & Dawson on "Electric Traction with Special Reference to the Installation of Elevated Conductors" is published in the Lond. "Elec. Eng." Nov. 9 with a large number of illustrations, and in part in the Lond. "Elec.;" it appears to consist principally of a description of American practice.

Liverpool Railway.—A correspondent to the Lond. "Elec. Rev." Nov. 9 suggests how the much criticized efficiency of 88 per cent. may be reduced to a "reasonable" quantity and obtains 68 per cent.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Accumulator Station.—The "Zeit. feur Elek.," Nov. 1, publishes an article by Mr. Strauss describing an installation at Kijew containing 72 E. P. S. cells; from a table of outputs and efficiences covering a period of nearly three years, the average ampere-hour efficiency was 83 per cent., and the watt-hour efficiency 68 per cent., during which time they were charged and discharged almost daily; no important repairs were made during that time.

Parallel Running of Overcompounded Machines.—In a communication by Mr. Phillimore to the Lond. "Elec.," Nov. 9, he describes briefly a method which is claimed to be perfectly automatic, but which necessitates the use of as many pairs of leads between the machines as there are machines.

Southport.—A description with good illustrations is published in the Lond. "Elec. Rev.," Nov. 9; an alternating current system with 2,000 volts and sub-stations is used; there is nothing essentially new in principle. A long and profusely illustrated description is published in the Lond. "Elec Eng.," Nov. 9.

Bolton.—A description with good illustrations, is published in the Lond. "Elec. Rev.," Nov. 9.

Municipal Electric Lighting.—A description of the Hampstead station by W. H. Preece, is published in the Lond. "Elec.," Nov. 9.

Train Lighting.—An installation on a French railway is described in "L'Elec.," Nov. 3, giving data and costs.

Design and Specification for Electric Lighting Works.—In the Digest, Oct. 27, attention was called to a series of articles by Messrs. Pentland & Gibbings, which is being published in London "Electricity," beginning with Oct. 5. The remark that it appeared to be a reprint of a book should have read that it appeared to be an advance publication of a book. The editor of the journal has stated to us that the series is entirely original and is being written for that paper; it is intended for architects and civil engineers, to enable them to design, specify, and inspect small installations.

Gas Engines—The leading editorial in the Lond. "Elec. Rev." Nov. 9, discusses recent publications regarding gas engine competition.

WIRES, WIRING AND CONDUITS.

Inductance in Aerial Lines.—Mr. Blondel's mathematical article is continued in "L'Eclairage Elec.," Oct. 27; he discusses the applications.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphing Without Metallic Conductors.—The system of Mr. Rathenau, mentioned in the Digest last week, is described with illustrations in the "Elek. Zeit.," Nov. 8. After mentioning briefly the results accomplished by Preece and Stevenson, he describes his system which he claims is based on conduction; if two plates are immersed near the shore of a river, lake or ocean, some distance apart from each other, and if a current be passed from one to the other through a land line, the return current through the water will pass through paths somewhat similar to those of magnetic lines of force; if a good conductor is placed parallel to these lines some distance from the shore it will, as it were, condense the current paths which are in its neighborhood; the currents in this circuit are then passed through some suitable receiver; it is claimed that there is, therefore, no induction, but a mere conduction. In the tests the shore line circuit included a battery of 55 accumulators, an interrupter, a telegraphic key, a resistance and measuring instruments; the receiving line held between two boats, was about 1,500 to 3,000 ft. long, terminated in two zinc plates and had two telephones in its circuit; the experimental plant was installed in the River Havel. The regularly pulsating current produces a humming in the telephone; the Morse alphabet is used; a number of tests were made, but the apparatus was not well adapted for them; only 3 amperes and 150 interruptions could be used, while owing to the poor conductivity of the water, the surface of the plates had to be 15 sq. m.; in spite of this however, signals were clearly received at 2.7 miles with a distance between the primary electrodes equal to about 1,600 ft.; (Preece communicated to a distance of 3.9 miles with a length of primary wire of 14,000 ft.); the limit of signalling was, however, by no means reached. Lord Rayleigh has shown that with oscillations of about 600, the telephone is about 600 times as sensitive as with 130 periods per second, and for this reason he suggests making the interruptions with a tuned reed and also to tune the telephone membrane to the same note; the former may also be accomplished by an alternating current machine of the desired frequency; tuning the receiver and transmitter will also enable different communications to be held through the same body of water; the resistance of the secondary circuit must be reduced as much as possible as both theory and experiments have shown that the current decreases more rapidly than in proportion to the increase of resistance. One of the most important and most difficult problems is the construction of the call, for the solution of which he suggests increasing the currents by a microphone placed on the membrane and operating a delicate relay; such an apparatus is now under construction; regarding the recording of the signals, an instrument was suggested based on the Wien optical telephone, in which the acoustic signals are transformed into optical ones and then registered photographically; in conclusion he believes that by proper proportioning of the various parts and by finding the best conditions, the distance may be increased very materially. In an editorial discussion it is stated that the results are far superior to those of Stevenson; the present method has the advantage of simplicity and the necessary apparatus can be erected quickly and easily, for which reason it may be of importance in field telegraphy. The question, how much of the transmission is due to induction and how much to conduction, is of importance in further researches; a method to determine this is suggested.

Microphone.—Mr. Munro in a communication to the Lond. "Elec." Nov. 9, states that he proved in 1883, that besides the sonorous vibrations of the points, there is an attraction and repulsion due to the current and varying with its strength; also that the microphone is reversible, and can, therefore, be used both as a receiver and transmitter; the attraction and repulsion can be seen on a large scale in the jumping of carbons in an arc lamp; he believes that the Edison motograph and Gray's physiological telephone are based on this same phenomenon.

Inducton in Telephone Circuits.—The paper mentioned in the Digest, Nov. 10, is concluded in the "Zeit. feur Elek.," Nov. 1.

Indian Telegraphs.—The Lond. "Elec. Eng.,' Nov. 9, contains a short paragraph giving some statistical information.

ELECTRO-CHEMISTRY.

Aluminium Sulphide and Clay as a Source of Aluminium.—According to the Lond. "Elec. Rev.," Nov. 9, Mr. Boucherer showed several years ago that aluminium sulphide is a convenient source for preparing the pure metal electrically; one of the advantages over the oxide is that less energy is required, the carbon is not attacked and the sulphur can be recovered. In this connection attention is called to a paper by Mr. Gruy in the "Zeit. feur Angewandte Chemie," 1894, page 290, in which he describes a new process for producing the sulphide; a bath is made of the double chloride of sodium and aluminium added to fused sodium sulphide, forming aluminium sulphide and sodium chloride; the fluoride of aluminium behaves in the same manner as the chloride; clay may be used as a raw material, aluminium sulphate being formed when it is decomposed with sulphuric acid, the sulphate being fused with sodium fluoride, giving aluminium fluoride, from which as before the sulphide may be obtained.

Electro-deposition of Gold.—In the Lond. "Elec. Rev.," Nov. 9, Mr. Andreoli discusses and criticises unfavorably a recent paper by Mr. von Gernet on the Siemens process. The article does not permit of being abstracted, but he intimates that the process could be greatly improved and gives some figures regarding the works at Worcester.

Cadmium Yellow.—According to a note in "L'Elec.," Nov. 3, it may be produced by electrolysing a solution of chloride of sodium between cadmium electrodes, passing sulphuretted hydrogen through the bath, the color varying with the conditions; antimony vermilion may be produced in the same way by using electrodes of antimony.

New Accumulator.—A brief description of the Tauligne accumulator (see Digest, July 7), is published in "L'Eclairage Elec.," Oct. 27; no more information is given than is contained in the Digest abstract.

Accumulators.—The article of Mr. Leroy (see Digest, Nov. 3), is abstracted in the Lond. "Elec. Rev.," Nov. 9.

MISCELLANEOUS.

Central Station Currents in Electro-therapeutics.—"L'Elec.," Nov. 3, publishes an article by Mr. Meylan, in which he discusses some important points in the application of alternating currents from central stations for therapeutical purposes. He describes the installation of Messrs. Gautier and Larat, in which such currents have been used for a number of years; d'Arsonval has shown that peculiar effects are produced in organisms by sine currents in which for a given maximum intensity the instantaneous variations are smallest; an incomparably larger current can be taken than if the current is of the faradic kind. The currents used in an electric bath should not exceed 100 milliamperes and more often 40 to 60 milliamperes at 10 to 15 volts, and it is therefore necessary to reduce the 100 volts of the lighting circuit; he suggests as the best means, a transformer for lowering to 15 volts, this current being then reduced as much as is desired by another transformer whose primary is movable as usual; there is then never any fear of obtaining a shock; in the method of Gautier and Larat, however, the voltage is reduced by a choking coil in series and then transformed by means of a small coil; opening the switch in that case could, under certain conditions, give a very serious shock. He then gives a number of measurements made with such baths with electrodes having an area of 700 square centimeters; the results show that the resistance of the water in a bath-tub was about 177 ohms; they showed that the voltage, if a choking coil is used, varies considerably with the resistance of the secondary circuit; their measurements in another installation are given, and from these the resistance of the human body in the bath tub was found to be 1,360 ohms, while the resistance of the water which it displaces was 935 ohms, showing that the human body offers a somewhat greater resistance than the same volume of water; the current which passed through the body was about one-tenth of the total, in this case 10 milliamperes, the frequency being 40, and this should be considered as the maximum for a normal person; a very robust person could stand only with difficulty a sinusoidal current of 13 milliamperes with a frequency of 60, with two large electrodes in the hands, the resistance of the body being 2,000 ohms. He shows the advantages of using two transformers instead of a choking coil and a transformer, and gives as another reason that the waves of the final current are nearly like those of the original, while the introduction of the choking coil modifies the form of the current very considerably; this is shown by a set of curves, from which he concludes that the physiological effects of the irregular curve, produced by a choking coil, are very different from those produced by a sine current, as the curve of the former passes quickly from a positive maximum to zero and very slowly from zero to the negative maximum; he concludes that in general the choking coils modify the curve less the more their magnetic circuit is opened, all other things being equal, especially the ratio of the resistance to the self-induction; it is an advantage also to have the iron circuit of the transformer an open one.

Moonlight Tables for January, 1895.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of January under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	9.10 P. M.	2	6.20 A. M.	1	5.10 P. M.	2	6.20 A.M.
2	10.10 "	3	6.20 "	2	5.10 "	3	6.20 "
3	11.10 "	4	6.20 "	3	5.10 "	4	6.20 "
4				4	5.20 "	5	6.20 "
5	12.10 A. M.	5	6.20 A. M.	5	5.20 "	5	12.00 M.
6	1.10 "	6	6.20 "	6	1.10 A. M.	6	6.20 A.M.
7	2.20 "	7	6.20 "	6	5.20 P. M.	6	12.00 M.
8	3.30 "	8	6.20 "	7	2.20 A. M.	7	6.20 AM.
9	4.50 "	9	6.20 "	7	5.20 P. M.	7	12.00 M.
10	No light.	10	No light.	8	5.20 "	8	"
11	"	11	"	9	5.20 "	9	"
12	5.30 P. M.	12	7.50 P. M.	10	5.20 "	10	"
13	5.30 "	13	9.00 "	11	5.20 "	11	"
14	5.30 "	14	10.20 "	12	5.30 P. M.	12	"
15	5.30 "	15	11 30 "	13	5.30 "	13	"
16	5.30 "	17	12.50 A. M.	14	5.30 "	14	"
17	5.30 "	18	1.50 "	15	5.30 "	15	"
18	5.30 "	19	3.00 "	16	5.30 "	17	12.50 A.M.
19	5.30 "	20	4.10 "	17	5.30 "	18	1.50 "
20	5.40 "	21	5.10 "	18	5.30 "	19	3.00 "
21	5.40 "	22	6.10 "	19	5.30 "	20	4.10 "
22	5.40 "	23	6.10 "	20	5.40 "	21	5.10 "
23	5.40 "	24	6.10 "	21	5.40 "	22	6.10 "
24	5.40 "	25	6.10 "	22	5.40 "	23	6.10 "
25	5.40 "	26	6.10 "	23	5.40 "	24	6.10 "
26	5.40 "	27	6.10 "	24	5.40 "	25	6.10 "
27	5.40 "	28	6.10 "	25	5.40 "	26	6.10 "
28	5.40 "	29	6.10 "	26	5.40 "	27	6.10 "
29	8.00 "	30	6.10 "	27	5.40 "	28	6.10 "
30	9.00 "	31	6.10 "	28	5.40 "	29	6.10 "
31	10.00 "	1	6.10 "	29	5.50 "	30	6.10 "
				30	5.50 "	31	6.10 "
				31	5.50 "	1	6.10 "

NOTE.—These schedules are made up on sun time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

The Physical Review.

The Physical Review for November-December, 1894, contains a frontispiece portrait of Professor von Helmholtz and a very appreciative biographical sketch from the pen of Professor E. L. Nichols, who was one of his pupils. Dr. Frederick Bedell and Carl Kinsley have an extensive article on "A Study of the Residual Charges of Condensers and their Dependence upon Temperatures." This does not appear to differ from the paper on same subject read by the same authors before the American Institute of Electrical Engineers. In the note "On Some Magnetic Characteristics of Iridium," by Professor S. H. Brackett, the author finds that iridium as at present manufactured is presumably different from that used by Faraday as it possesses magnetic properties, very low permeability and great coercitive force with a high intensity of magnetism, were plainly exhibited by the specimens of iridium with which he experimented, and these characteristics are said to be consistent with the known physical laws on this subject. The paper on "A General Theory of the Glow Lamp," by H. S. Weber, of which we have published an abstract, appears to be concluded in this number, but we cannot be certain as the preceding section, beyond the addition of a Roman numeral to its title, had no indication that it was to be continued.

A Patent for Sale.

As an amusing example of the grist that sometimes comes to an editorial mill we print the following:

"As you will see from the inclosed circular, I have a good invention—read on: I haven't the money to work it like I want to, so I am going to make a *few good* papers this liberal offer:

"If you will cause me to sell my right to the invention, before the patent is granted, for $20,000, I will give you $10,000. It is worth $20,000 if it is worth anything, but if you cause me to sell it for $10,000 you get $5,000.

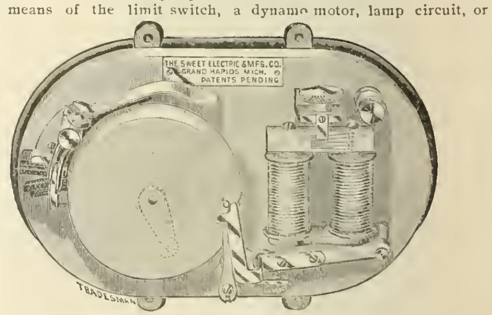
"Are you competent to be in the race? It would be with you whether you won or not. I cannot authorize you to sell the right as this might cause a double sale.

"If you accept this rare offer I will keep you posted with ideas. The advertisement would be worth three times the cost to your paper. You cannot lose anything on this. I will sell on no terms except Spot Cash."

Station Limit Switch.

We illustrate herewith an automatic limit switch, which, it is claimed by the makers, the Sweet Electric & Mfg. Company, Grand Rapids, Mich., never fails to open on a predetermined point, and is accurate and positive in its action; the adjustment is simple, there are no complicated parts to wear out, and it will last a lifetime. The breaking of the current between carbons is done in such a manner that when the metal contact is broken there is still another contact between carbons which are rotating, thus throwing in a resistance before the final point of breaking; this greatly reduces the volume of current, and, when the contact is finally broken, leaves no chance for the formation of carbon vapor as the motion is very rapid.

By means of the limit switch, a dynamo motor, lamp circuit, or



STATION LIMIT SWITCH.

whatever service it is in connection with, is entirely independent, for the reason that it is adjustable to one-tenth of an ampere and the current cannot exceed the amount to which the switch is adjusted without opening the circuit. This type of non-arcing limit switch is especially adapted for street railway motors, and is designed to take the place of fuse boxes; for double equipments it can be put in circuit with each motor, so that if a ground or short circuit occur, the switch cuts out the defective motor, leaving the good motor still in circuit for operation. The switch does not occupy very much space, being only 3x8x11 in. in size, and is circular in form and neat in design; it can be placed anywhere inside or outside of car in any position. The switch when set in position cannot open by any sudden jar whatever, but remains locked until opened by excessive current or otherwise by hand if so desired, there being a small push button on the outside when used as an ordinary cut-out. The adjustment is made by a small thumb screw, and the switches are made from 25 to 200 amperes capacity.

Electric Haulage in a Michigan Mine.

About two years ago the Pittsburg & Lake Angeline Iron Mining Company determined to install an electric plant, after having become convinced of the economy of the step. At the surface, a power house was

MINE HAULAGE ELECTRIC LOCOMOTIVE.

constructed, and a 14x30 Reynolds-Corliss engine erected to drive a D-62-500-volt General Electric bipolar generator. Armored mains are taken down the mine on porcelain insulators, and connected in the usual manner to the trolley wire and track.

The haulage plant proper consists of two General Electric T. M. M.-15,

MINE HAULAGE ELECTRIC LOCOMOTIVE.

30-in. gauge locomotives, each being equipped with two motors. The locomotives are capable of exerting a draw-bar pull of 1,500 lbs. each, at a speed of from six to eight miles an hour. The motors are of the iron-clad waterproof type.

The length of haul is somewhat short for locomotives, but is too long for profitable tramming by men, the distance averaging from 250 to 1,400 feet. The grade is 8 in. in 100 feet in favor of the loaded cars, and the curves are sharp, varying from 12 feet radius up, on account of the narrow veins. No serious delay has occurred since the plant began operation.

The cost of hauling at the present rate of working, which is not up to the capacity of the locomotives, is 2 cents per ton, including oil, waste and repairs.

Flexible Friction Clutch.

The flexible friction clutch we illustrate was taken up for manufacture by the E. W. Bliss Co., 17 Adams street, Brooklyn, N. Y., owing to the

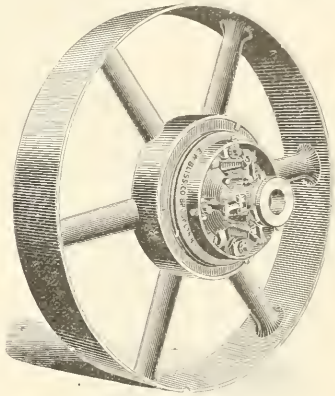


FIG. 1.—FLEXIBLE FRICTION CLUTCH.

difficulty they had experienced in finding for their own demands, which are very extensive, a clutch in the market that fulfilled the highest requirements.

The clutch consists of a friction disc flexibly connected to the pulley, against the sides of which the clutch members grip. Therefore, if the pulley wears out of true on the shaft, no difference results in the operation of the clutch, no undue strains are brought on any of the parts, and no adjustments are necessary to compensate for this wear. There are only two clutch members, one keyed rigidly to the shaft to which the levers are attached, and the other movable. This makes the adjusting

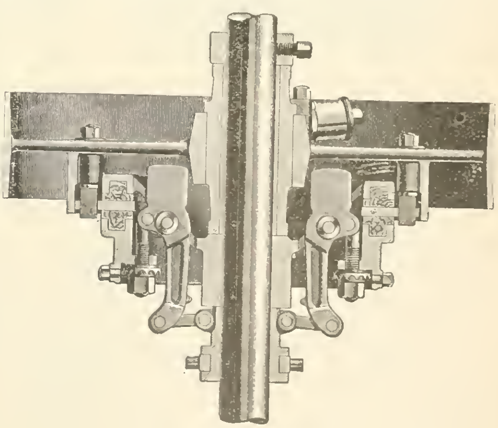


FIG. 2.—SECTION OF FLEXIBLE FRICTION CLUTCH.

of the clutch a very simple matter. The levers are so balanced that at any speed at which the shaft is run the centrifugal force has no tendency to throw the clutch in or out of operation. This is an important point, and one not found in the majority of clutches in the market. The clutch is constructed with very few parts, and is so put together that it cannot get out of order. Its clutching members are circular and concentric with the shaft, the only projecting parts being the levers, so that it not only presents a pleasing appearance when revolving on the shaft, but is in accurate balance, and may be run with safety at any reasonable speed. It is very compact, occupies small space on the shaft, and is so constructed that all parts are interchangeable. By means of a system of

bushings for pulleys so arranged that if, on account of long continued use, or where a poor quality of lubricant is used, the bore becomes worn, the bush can be returned and exchanged for one with a new lining at small expense. The horse-power which the various sizes of clutches will transmit is obtained from actual test by means of a dynamometer especially constructed for the purpose, and it is guaranteed that the clutch attached to any pulley will transmit more power than can be transmitted by a double belt the full width of the pulley.

The Monarch Engine Stop.

The object of the apparatus illustrated herewith, manufactured by the Monarch Engine Stop Company, 34 Maiden lane, New York, is to stop a steam engine or other motor from one or several points near or remote from the engine-room, by simply pressing an electric button, or automatically. A spocket wheel is keyed to the throttle valve stem just behind the valve wheel, and from this a chain leads to the stop, which is enclosed in a cabinet 14 in.x12 in. and 8 in. deep (Fig. 1) and which may be placed at any convenient location, either on the floor, bolted to the ceiling or fastened to the steam pipe, which takes it completely out of the engineer's way. The chain connects with another sprocket wheel attached to the main or driving shaft of the stop. This main shaft is connected with a spring of sufficient power to close any valve, which spring is encased in a brass or phosphor bronze drum cylinder or winding barrel, very similar to the winding device of a watch. The drum is geared to a second horizontal shaft, on the end of which is a piston working in a cushioning chamber or dash pot, filled with glycerine, which controls the closing of the valve by a by-pass, the opening or closing of which regulates the flow of glycerine, and consequently the speed with which the valve closes.

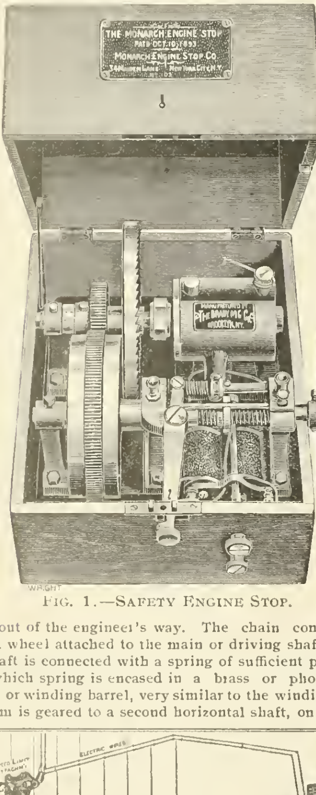


FIG. 1.—SAFETY ENGINE STOP.

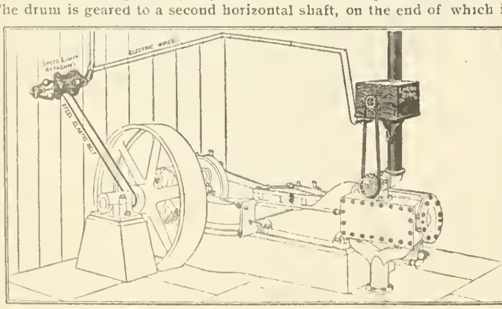


FIG. 2.—SHOWING ENGINE STOP INSTALLED.

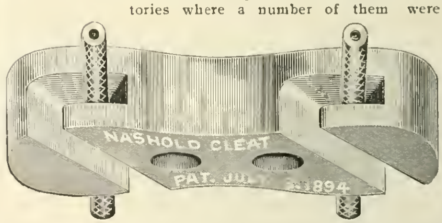
To the piston shaft is attached a ratchet wheel of brass or phosphor bronze, into which enters a sliding paul held in place by a spring controlled by an electric interlocking device, which holds or releases it at the will of the operator.

The method of its operation is as follows: The engineer on entering his engine room, presses a button conveniently placed, and if an answering click is heard in the box, he knows that the whole circuit of any number of stations in any part of the works, large or small, is in working order. He next, by opening the throttle, winds the drum spring and by pulling a lever throws the paul into the ratchet, and the machine is ready to work. Now should an accident occur in any portion of the works, near or remote, the simple pressing of a button anywhere on the circuit makes the electric connection, withdraws the paul from the ratchet wheel, which releases the spring, thereby shutting the engine down instantaneously without injury to the valve

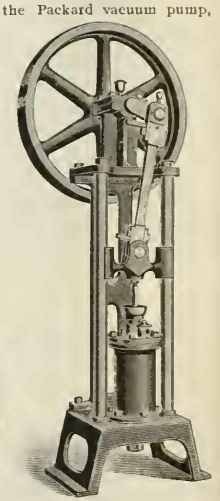
The automatic speed limit attachment (shown in Fig. 2) consists of a perpendicular shaft, to which is attached a V pulley connected to ball and springs similar to the ordinary spring governor. This receives its momentum from the main shaft of the engine by a spiral wire belt, which prevents slipping in event of any acceleration of speed. In case of the main belt breaking, or failure for any reason of the governor to control the engine, or the slightest increase of speed beyond the fixed limit (which may be at any number of revolutions desired), the centrifugal force or outward movement of the ball makes the electric circuit, and performs the same office as the pressing of a button anywhere in the circuit.

Improved Vacuum Pump.

We illustrate herewith a new model of the Packard vacuum pump, well-known to incandescent lamp makers, and manufactured by Norman H. Hubbard, 93 Pearl street, Brooklyn, N. Y. These pumps are almost universally used in incandescent lamp factories, where there are over 200 now in use, for the production of the preliminary vacuum in the lamps before the mercurial pump is set to work, for the operation of the mercurial pump and for producing a vacuum in the flashing bottles where the lamp filaments are subjected to the operation of flashing or "treating." The pumps have not heretofore been made with a single cylinder, as they were designed primarily for use in factories where a number of them were required and were, therefore, for the sake of compactness and economy of operation, made with two or three cylinders combined in each pump. To meet the demand for a high grade vacuum pump for use in laboratories and experimental work in lamp factories, the single cylinder design illustrated is now put on the market. For simplicity and compactness this is built with a single cylinder of large diameter and ample length. The frame, as will be seen, is open, making all parts perfectly accessible, and is perfectly rigid. The valve arrangement, which has lately been improved and strengthened, is precisely the same as in the larger sizes of Packard pumps, and the pump is in every way adapted to heavy, continuous work. A vacuum within one-half inch of the barometric pressure is readily obtained.



SELF-LOCKING CLEAT.



IMPROVED VACUUM PUMP.

New Self-Locking Cleat.

Considering the almost unlimited number of cleats which have been introduced in electric light and power installations, it is evident that much thought, time and money have been expended in the effort to bring about perfection in this essential device. A late and interesting addition to this branch is the Nashold self-locking cleat, manufactured by the Nashold Cleat Company, 934 Monadnock Block, Chicago, which the illustration given herewith enables to be clearly understood.

There is a full half-inch of porcelain between the point of contact of wire and ceiling, thus bringing the device within the requirements of underwriters, whose endorsement it has received after severe and exhaustive tests. One of the features claimed for the cleat is that it retains no moisture. The base of the holding point forms a ridge at the apex of which the wire crosses, and any moisture that might be in the surrounding atmosphere would have no more chance to collect than is unavoidable with any other section of the line. In installing, all that is required is to push the wire through the opening, then pull it straight, and it is held as strongly as in a vise. It enters and emerges from its anchorage on exactly the same lines, so that its appearance is as though it was pulled through a straight hole.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Nov. 24, 1894.

ELECTRICAL STOCKS can only become speculatively active in response to active trade conditions. The failure of business interests to respond in a marked degree to the hopes based on election results have of a necessity kept the more conservative electrical stocks somewhat in the financial background this week, so far as any actual trading is concerned. Nevertheless the old favorites find a ready market and there is no difficulty in obtaining a quotation.

GENERAL ELECTRIC has been unusually quiet, not a line of gossip has been circulated as likely to effect the trading in this security. It has not been marked with much strength. This is, however, entirely in sympathy with the general market, which, being left entirely to the professionals, has been directed on a bear tack as being along the line of least resistance. The logical trend of General Electric quotations is upwards, if it is to keep in accordance with the official statements, which are uniform in their announcements of growing prosperity. But the stock market tendency this week was downwards, and General Electric's course, while without significance, has not been an exqception.

WESTINHOUSE ELECTRIC.—Business continues to improve at a steady pace. The company is understood to have unfilled orders on hand amounting to $1,500,000. With the current orders this will give full employment to the new works. It is expected that the removal to the new plant will be completed by January 1; arrangements have been so completed that the task of removing the machinery will not interfere with the regularity of output, despite the fact that there are three months' orders on hand. The usual dividends on the preferred stock will be declared shortly. Officers of the company deny absolutely the rumor repeated in these columns last week that the dividend would be paid in script. The distribution will be, as usual, in cash, though Westinghouse scrip is not to be sneezed at. Some scrip issued at previous periods commands 98 in an open market.

THE BELL TELEPHONE stock authorized at the special stockholders' meeting on the 15th inst. will, according to Secretary of State Olin, of Massachusetts, be offered to shareholders at 190. The issue, as already herein related, is 5,000 shares; this lot is offered as an experiment under the regulations recently enacted by the Legislature, relative to the increase of the company's capital from $20,000,000 to $30,000,000. Should this sale be successful, from the company's standpoint, the other $25,000,000 new stock, which President Hudson says are necessary for the extension of the company's lines, will be issued in similar fashion. The "market" price of the new 5,000 share issue was fixed by Commissioner of Corporation Endicott, but it has not effected the Stock Exchange quotations to any extent. It is 196 asked. There is no likelihood, despite talk to the contrary, that the new issue will interfere with dividends at present rates. A Boston banker, prominently identified with company interests, but of his own wish nameless, says that "the public will see that the higher American Bell Telephone stock sells, the more certain it is that the 18 per cent. dividend rate will be maintained.

WESTERN UNION TELEGRAPH has kept the so-called industrial group company in a slight decline. The bears have directed some particular efforts against this security, basing their campaign on the reports of damage occasioned by the storms prevailing all during the month. Certainly the company suffers from this cause, not so much by the direct damage to property as through the loss of revenue through the compulsory interference with operations. Then, too, the new constitutional amendment forbidding gambling in New York State will cut off the old, lucrative pool room business, and a good deal of harping is done on this string. President Eckert says, however, that earnings are improving, especially in the South, which indicates a general improvement in business.

AMERICAN DISTRICT TELEGRAPH directors adjourned their recent meeting till the latter part of next month, so no action is yet taken on the declaration of a dividend, but it is felt that the interruption of declaring a dividend is only temporary.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	100½	101½
" " " Brooklyn	100	109	112
" " " Boston	100	125	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	34¾	35
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	34½	35½
" " pref	50	51	52

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	107¼	107¾
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	91

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	194	196
American District Telegraph	100	40	45
American Telegraph & Cable	100	88	91
Central & South American Telegraph	100	102	105
Commercial Cables	100	125	145
Erie Telephone	100	52½	53
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
New England Telephone	100	67	69
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	87½	87⅝

Ex-div.

THE FORT WAYNE ELECTRIC CORPORATION 6 per cent. debenture bonds had the third installment paid on them this week. These are the bonds for which the old Fort Wayne Electric Companys' stockholders subscribed for in the re-organization. No quotations as to these bonds come to light, as they are not yet traded in. It will be remembered that the bonds were offered at 90, payable 10 per cent. in cash by October 1, 40 per cent. in cash by October 31 and 50 per cent., on or before November 20 either in cash or in old Fort Wayne Electric Company stock at $5, or in both stock and cash.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES trustees purchased and cancelled 586 shares of preferred stock with the $50,000 set aside last week for this purpose; the average price per share paid for this lot was $102.35, the first lot being bought in under 90. The present purchase makes a total of 17,693 shares retired to date.

THE TRACTION STOCK MARKET this week continued to respond to the demand for street railway issues in vogue now for some time, all good issues meeting with ready market. Philadelphia securities have fluctuated more than others by reason of the speculative interest attached to them, but the good earnings reported by other out of town roads has kept quotations up to recent records. What with the spread of knowledge of these stocks and the increased favor with which they are regarded by investors by reason of their possibilities for money making, there is an ever-growing disposition to add more of these securities to the few now dealt in on the New York Stock Exchange. The great interest taken in the Philadelphia stocks by many local operators will soon make it necessary to give a local opportunity for dealings in such stocks as Metropolitan Traction, Philadelphia Traction, etc., and already a concerted effort is being made to list these speculative favorites on the New York Stock Exchange. Boston advices supplement the above remarks by the statement that there is a good reason to believe that much of the recent buying of traction stocks there has been for New York account and this means that one or two of them, especially West End Street Railway common, will ultimately be listed here. New York operators know a good thing when they see it and they are not generally the kind to let it slip by.

BOSTON trading in electric traction stocks has this week been given over to transactions in West End Railway, whose annual report for the year ending Sept. 30, 1894, just published, shows a surplus after dividends of $98,356, a loss, as compared with 1892-93. The report, however, brought about good buying, and 60 is talked of for the common stock. President Little says that "there is cash enough on hand to cover the expense of finishing the electric equipment now under way and contemplated." It is expected that electric power will be inaugurated on the East Boston division by the middle of December.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	65	68
" " common	15	16
Long Island Traction	12½	13
Rochester St. Ry	39½	40
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	56	58
North Shore Traction	22½	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	107	108
Philadelphia Traction	102	102½
People's Traction	55	55½

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. m. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	95	97

*With accrued interest.

NEW INCORPORATIONS.

THE PAINESVILLE TELEPHONE COMPANY, capital stock $10,000, has been incorporated.

THE DEARBORN ELECTRIC COMPANY, Chicago, Ill., has been incorporated by T. C. Rafferty, Charles Messer and J. P. Rafferty, with a capital stock of $25,000.

THE MOUND CITY ELECTRIC LIGHT AND POWER COMPANY, Mound City, Ill., has been incorporated by A. J. Dougherty, E. G. Bruckman and S. E. Bruckman with a capital of $50,0000.

THE UNION TELEGRAPH AND TELEPHONE COMPANY, Pittsfield, Mass., capital stock $5,000, has been formed for the transmission of intelligence by electricity. S. N. Fuller, Michael Casey and R. A. Burget are interested.

THE CITIZENS' LIGHT AND POWER COMPANY, Sullivan, Ind., capital stock $15,000, has been incorporated to supply light, heat and power. Neah Crawford, Silver Chaney and Mary A. Crawford, Sullivan, Ind., are interested.

THE PHILADELPHIA AND LANSDALE RAILWAY COMPANY, Philadelphia, Pa., has been incorporated to construct, maintain and operate an electric railway. Robert A. Welsh, H. A. Mullen and John H. Moffit, Philadelphia, are interested.

THE UNION TELEGRAPH AND TELEPHONE COMPANY, Pittsfield, Mass., capital stock $5,000, has been incorporated for the transmission of intelligence by electricity. S. N. Fuller, Michael Casey and R. A. Burget are interested.

THE MOUNT CARROLL ELECTRIC LIGHT COMPANY, Mount Carroll, Ill., capital stock $12,800 has been incorporated to establish and operate an electric light and power plant. Owen P. Miles, Wm. Q. Sayers and Oscar F. McKenney are interested parties.

THE MONTPELIER ELECTRIC LIGHT COMPANY, Montpelier, Vt., capital stock $15,000, has been formed to supply electric light, heat and power. The promoters are John P. McGeath, John A. Remy, Hartford City, Ind., and Allen M. Hall, Kokomo, Ind.

CARTHAGE, WEBB CITY, JOPLIN AND GALENA ELECTRIC RAILWAY

COMPANY, St. Louis, Mo., capital stock $175,000, has been incorporated. John J. Taussig, David R. Powell, St. Louis, Mo., Charles C. Carroll, Springfield, Ill., are interested.

THE PHILADELPHIA AND LANSDALE RAILWAY COMPANY, Philadelphia, Pa., capital stock $100,000, has been incorporated to construct, maintain and operate an electric railway. Robert A. Welsh, H. A. Mullen, John H. Moffit, Philadelphia, Pa., are the promoters.

THE S. K. C. SPECIALTY COMPANY, Pittsfield, Mass., capital stock $12,500, has been incorporated for the manufacture and sale of machines, apparatus, tools, electrical appliances and novelties. R. de W. Sampson, Wm. Gardner, John F. Kelly and C. C. Chesney are interested.

WILDER SLOSS ELECTRIC HOTEL CALL COMPANY, Chicago, Ill., capital stock $250,000, has been incorporated to manufacture, sell and deal in electrical devices and all articles pertaining to any electrical device. Louis Stein, Augustus Binswanger and E. R. Wilder are interested.

THE JASPER COUNTY ELECTRIC RAILWAY COMPANY, St. Louis, Mo., capital stock $50,000, has been incorporated by John W. Halliburton, Samuel Reynolds, Isaac Perkins and others, to construct an electric railway from Carthage to Cartersville, Webb City and Joplin, a distance of 15 miles.

THE NATIONAL ELECTRICAL REMINDER COMPANY, Chicago, Ill., capital stock $250,000, has been formed to manufacture and sell electrical devices, appliances, instruments, etc., and to buy and sell patent rights. Siegfried Rosenfield, Augustus Rosenfield and David C. Thoms are interested.

THE SHEDLOCK AUTOMATIC BRAKE COMPANY, Jersey City, N. J., capital stock $250,000, has been formed to manufacture and sell brakes for cars propelled by steam, cable, electric or horse power, etc. Alfred Shedlock, Jersey City; Wm. H. Foster, Elizabeth, and Anderson Price, Rutherford, N J., are the organizers.

THE SECOND AVENUE TRACTION COMPANY, Pittsburgh, Pa., capital-stock $10,000, has been formed to construct and operate motors and cables or other machinery for supplying motive power to passenger railways. G. T. Hamilton, Edgewood, Pa.; W. L. White, T. W. Hierker, Pittsburg; H. J. Stern, Avalon, and W. T. Ford, Allegheny, Pa.

NORTH AMERICAN INTERIOR TELEPHONE COMPANY, OF BALTIMORE CITY, Baltimore, Md., capital stock $60,000, has been incorporated to manufacture telephones, telephone appliances, electric switches and other electrical machinery. Fred. K. W. Schulz, J. Kemp Bartlett, Jr., Seneca P. Bromal, Charles C. Hughes and Thomas R. Brimmer are the promoters.

THE SECOND AVENUE TRACTION COMPANY, Pittsburg, Pa., capital stock $10,000, has been incorporated to construct and operate motors and cables or other machinery for supplying motive power to passenger railways. G. T. Hamilton, Edgewood, Pa.; W. I. White, T. W. Dierker, Pittsburg, H. J. Stern, Avalon, Pa., W. T. Ford, Allegheny, Pa., are interested.

THE INTERNATIONAL COPPER SMELTING COMPANY, Jersey City, N. J., capital stock $5,000, has been incorporated to smelt and refine copper ore and other metals in all branches by means of electric, chemical, fire, or other process. Geo. Lowther, Riverside; Ed. L. Smith, Francis M. Smith, Ansonia, Conn.; Thos. K. Egbert, Pattenberg, N. J.; Chas. H. Brush and Henry I. Uderitz, Brooklyn, N. Y., are the organizers.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Nov. 24, 1894.

THE STATE RAILROAD COMMISSIONERS have granted permission to the Nassau Electric Railroad Company, of Brooklyn, to use the overhead trolley system in New York avenue, from Fulton street to Atlantic avenue.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION, under date of November 22, informs us that the eighteenth Convention of the Association will be held at Cleveland, Ohio, February 19, 20 and 21, 1895. Headquarters will be at the Hollenden Hotel, and the meetings at Army and Navy Hall.

THE INTERIOR TELEPHONE COMPANY, of New York City, is very much gratified with the results attending the sale of its telephones since its introduction to the public. The company claims that its combination is the only one which does not infringe any of the Bell patents.

MR. WILLARD M. MINER has resigned the general managership of the American Manufacturing and Engineering Company, in which company, however, he still retains an interest, and will devote most of his time hereafter to the Bi-metallic Electric Transmission Company, 80 Broadway, of which company he is vice-president. In addition Mr. Miner will do a general expert and consulting business.

SEALED PROPOSALS will be received by the Department of Charity and Corrections, Kings County, N. Y., until 12 m., Nov. 28th, at the office of the Secretary of the Board, 29 Elm place, Brooklyn, N. Y., for furnishing supplies for the use of the department, consisting, among other things, of electrical supplies. Schedules (ready for distribution), with full particulars, can be obtained at the above address. The commissioners reserve the right to reject any or all bids. A. Simis, Jr., is president and Bernard Lamb, secretary.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
November 24, 1894.

THE NASHOLD CLEAT COMPANY, of 934 Monadnock Block, is busy filling orders for its new cleat. This has met with an instantaneous success.

F. E. DONOHOE, Western manager for the American Electrical Works, has closed an order with President Yerkes, of the North Chicago Railway Company, for $118,000 worth of wire for use on the new electric lines to be equipped in the near future. This is claimed to be the largest wire order ever placed, and Mr. D[illegible]hoe is justly proud of his achievement.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY reports business as brisk as ever. The Hartford City, Ind., exchange will be started during the week. They are replacing 50 'phones of another make at Shelbyville, Ill., and installing their new No. 1. The week's shipments include 150 instruments for the new exchange at Fostoria, O. The new Keelyn automatic switchboard will replace the Strowger now in use in the private exchange at the Johnson Company, Johnstown, Pa. President Keelyn has started on a trip to the Coast, to be gone some time on business.

Canadian Notes.

OTTAWA, Nov. 20, 1894.

WINNIPEG.—It is said the capacity of the Northwest Electric Light Company will be doubled next season, and that the company will expend $40,000 in plant, extensions, etc.

MONTREAL.—Application has been made for a charter of incorporation by "The Stadacona Water & Light Company," at Montreal. Capital stock $40,000. The objects of the company are to build aqueducts and furnish water and light to towns and villages in the province.

AYLMER, QUE.—The town council has passed a by-law granting a twenty-year charter to the Hull Electric Railway Company for the operation of an electric railway between Hull and Aylmer and through the streets of the latter town. It is expected the road will be in operation by July next.

BROCKVILLE.—A. B. Wilgus, of Boston, representing a company of American capitalists, has made a proposition to the city council offering to build an electric street railway in Brockville. They ask for a twenty-year franchise, an acre of ground for buildings, exemption from taxation and permission to run the cars on Sunday.

THE ANNUAL MEETING of shareholders of the Montreal Electric Street Railway was held last week. The election of directors resulted as follows: L. J. Forget, James Ross, H. A. Everett, K. W. Blackwall, G. C. Cunningham. At a subsequent meeting Mr. Forget was made president, Mr. Ross vice-president and managing director, Mr. Cunningham manager. Mr. Ross takes Mr. Everett's place on the board as vice-president, and Mr. Cunningham's as managing director.

OTTAWA.—For a week past negotiations have been in progress for the establishment of a large factory in Ottawa for the production of porcelain ware, carbons, etc., connected with the electrical demands of the present day. The plans of the company comprise the erection of a building two stories having two kilns for burning the carbons, and several workshops suitable for the employment of from 50 to 100 skilled artisans at the start. The building will cost about $30,000 without machinery.

ST. JOHN, N. B.—The electric railway people made application to the mayor of the city requesting him to rescind the order which he issued on Tuesday forbidding the company to run their cars. The mayor refused to grant their request, contending that it would not be safe for the company to turn on the electric current until all the wires which had been knocked down by the storm were repaired. The company, on the other hand, contend that the road can now be operated with perfect safety and threaten to sue the city for damages for every day that the cars are stopped.

MONTREAL.—President Thibaudeau, of the Royal Electric Company, states that an arrangement had been made with the Stanley Electric Company, of Pittsfield, Mass., whereby they would supply the Royal Electric with all their patents and models in the future on which would be paid a royalty. In a few days the company would commence to build new workshops, and would immediately go ahead with its new arrangement. It is said there will likely be some changes at the Royal Electric Works, as some of the officials of the Stanley Company will have to come here, for a time at least.

MONTREAL.—The Recorder of this city has imposed a nominal fine on the Electric Street Railway Company for overcrowding their cars. One car licensed to carry 36 passengers was found with 50 passengers on board. The judge, in rendering judgment, said: "I understand that it is difficult to prevent overcrowding on the cars, owing to the persistency of the public in boarding them, but, so long as the city by-laws restrict the carrying capacity of the cars to a certain number, the company must obey the rules or suffer the consequences. If the company objects to the by-laws and finds it impossible to obey them, it must either get them repealed or pay for breaking them."

News of the Week.

Telegraph and Telephone.

CHICAGO, ILL.—The Chicago Telephone Company will erect a telephone exchange on 55th street.

SALISBURY, MD.—Active preparations are being made to reorganize a company to erect the Wicomico County telephone line, which will be worked in connection with the Salisbury Telephone Company.

WASHINGTON, D. C.—Sealed proposals will be opened on December 16, by the Department of the Interior, Washington, D. C., for the construction of a telephone exchange system. W. H. Sims is acting secretary.

RAHWAY, N. J.—A new telephone company has been organized, with the following incorporators: Charles Oliver, H. B. Robinson, Wm. Howard, Wm. Chamberlain, Ferdinand Thompson and W. J. Lansley. The object of the company is to supply the local telephone service to Rahway at low prices.

Electric Light and Power.

MT. JEWETT, PA., is to have electric lights.

SAULT ST. MARIE, ONT.—Electric lighting station has been burned.

EAST PALESTINE, O.—The citizens are agitating the question of electric lights.

WELLSBORO, PA.—T. B. Field & Son, Wellsboro, Pa., want to purchase a 75-light dynamo.

ROGERS, ARK.—Address the Mayor concerning the purchase of an $8,000 electric light plant.

AUSTIN, MINN.—The Committee on Lights was authorized to contract for 20 additional arc lights.

BUNKER HILL, MO.—Address the Mayor concerning the establishment of a proposed electric light plant.

NYACK, N. Y.—The Nyack Reformed Church building will employ both electricity and gas for lighting.

MOUNTAIN LAKE PARK, MD.—Machinery will be wanted for electric light plant. Address J. C. Alderson.

PORTSMOUTH, VA.—The Portsmouth Street Railway Company asks permission of Council to extend its tracks.

RENOVO, PA.—The electric light plant of Renovo is to be enlarged by the erection of a new building 50x30 feet.

PLATTSBURG, MO.—It is stated that the citizens are agitating the question of electric lights. Address the Mayor.

WINNIPEG, MAN.—The Northwest Electric Light Company will double its capacity next summer, spending $40,000.

SPRINGFIELD, MASS.—The city officials favor an electric lighting plant at the almshouse and the Wayfarers' lodge.

WATERFORD, N. Y.—At a meeting of the Town Board it was decided to appropriate $1,150 for electric street lighting.

PALATKA, FLA.—E. E. Haskell is seeking from the Council a 25-year franchise to supply the city with electric lights.

BREMEN, IND.—Plans and specifications are being prepared for the erection of the electric light plant. Bids will soon be called for.

ELWOOD, IND.—One of the boilers at the electric light and power house exploded, demolishing the building and wrecking the street car barns.

SYRACUSE, N. Y.—It is the intention to have subways built in the spring, and the Council will probably order all the wires of the city under ground.

LEBANON, PA.—Samuel Bell's Sons have secured the contract for the erection of the new boiler house at the Edison Illuminating Company's works and will begin the work immediately.

HOOSAC FALLS, N. Y.—Charles B. Story, lessee of the park and lake on the premises of Hon. S. D. Locke, has made many improvements on the grounds. The park will be lighted by electricity.

QUINCY, MASS.—At a meeting of the Quincy City Council, an order was passed authorizing the Mayor to petition the legislature for authority to establish a municipal electric lighting or gas plant.

FLEMINGTON, N. J., has plans for electric light under discussions and a committee consisting of Messrs. Alexander B. Allen, John F. Schenck and F. R. Williamson will visit Newton to examine the plant there.

EDWARDSVILLE, PA.—The borough attorney instructed the members of the Council to investigate as to the number of lights and their cost and let the people decide at the election to be held in February next.

ALLEGHENY, PA.—At special meeting the Common Council will in all probability appoint a committee of conference on the electric light contract. It is not expected that the conference committee will accomplish anything.

LONG ISLAND CITY, N. Y.—The aldermen held a special meeting to pass upon the specifications and form of contract with which those submitting proposals for furnishing electric, gas or other lights must comply, which were adopted.

ELM GROVE, W. VA.—Efforts are being made to form a company to construct water works, together with an electric light plant at Elm Grove and seem likely to be crowned with success. The city water board can probably give information.

SUMMIT, N. J.—The Township Committee has submitted propositions under which an electric light franchise will be granted and all bids are to be given in at the next meeting. The committee will exact a bond and favor an underground system.

SHENANDOAH, PA.—A meeting of citizens of the town will be held to take action towards organizing an independent electric light company. Several citizens are now negotiating to secure private plants. Max Schmidt, the dry goods dealer, is one of those interested.

PHILADELPHIA, PA.—The Electrical Committee of Common Council met to consider the Edison Electric Light ordinance, granting certain privileges to that company in the way of occupying the city streets with underground conduits. The bill was referred back to the Common Council.

MILLEVILLE, N. J.—The Common Council of Millville is fighting against the efforts of the Millville Electric Company to raise the rates for lighting the city. The Council has decided not to accept the proposition and the Lighting Committee was instructed to advertise for proposals.

GALESVILLE, WIS.—The village board has granted a 15-year franchise to D. M. Benton & Company for electric lighting purposes. This was done because Benton refused to extend his plant unless some protection was given him. He has two machines and will run about 800 lights.

NEW YORK, N. Y.—The plans for the proposed New York theater, that Messrs. Canary & Lederer propose erecting at the northwest corner of Seventh avenue and Forty-second streets, have just been completed by John D. Allen, architect, of Philadelphia. The illumination throughout will be by electricity.

ST. JOSEPH, MO.—An ordinance granting to Houston Wyeth the right to construct and operate an electric light and power plant in this city was introduced in the Council. If the franchise is granted the plant will be operated in connection with the St. Joseph Artesian Ice Company, where the same machinery can be used for both purposes.

CUTHBERT, GA.—M. F. Sullivan, of Mable & Sullivan, Atlanta, is making surveys for the proposed works and eletric light plant. Bids for the contract work will be asked for when specifications are completed. The city has issued $50,000 in bonds, and the $40,000 or $45,000 necessary to construct the plant will probably be sold at private sale this month.

MIDDLETOWN, O.—The official returns show that the Middletown Electric Light & Power Company has been voted a franchise to establish a plant, and it has been awarded the contract for lighting the city for the next ten years. Work on the new plant will be commenced at once, and it is promised that the new light will be in operation by Christmas day.

NEW HAVEN, CONN.—The committee appointed by the Selectmen to go to Hartford and present a petition to the Legislature for a special appropriation of $40,000 to provide some means of transit to the top of East Rock Park, are in favor of an elevator, and strongly oppose Mayor Sargent's plan to grant permission to the electric railroads to build a line to the top of the rock.

MILWAUKEE, WIS.—The Milwaukee Arc Light Company's plant has been sold to four of its directors. It is said that the amount they paid to the remaining stockholders was $86,500, but this does not represent the capital stock. The company was originally capitalized at $150,000, but an inventory made not long since put a valuation of $136,500 at a close estimate

OWASSO, MICH.—Sealed proposals are wanted for lighting the streets and the city buildings of the city of Owasso for the term of one and three years from and after April 1, 1895, at any time previous to the hour of 4 p. m., of December 1, on the following basis: Sixty or more 2,000-cp arc lamps; also 60 or more 1,200-cp arc lamps; and 16 and 32-cp incandescent lights for the city. H. Frieseke is chairman.

MILWAUKEE, WIS.—The Board of Public Works has decided to send a communication to the Common Council recommending immediate action in the matter of providing lighting apparatus for the city hall. This is a big item of expense, requiring about $50,000. The wiring will cost about $18,000, and the dynamos, engines, etc., about $32,000 more. The board will ask that it be given authority to advertise for bids for the work.

KALAMAZOO, MICH.—A special election was held November 6, at which two propositions were submitted to the voters. One, authorizing the City Council to construct an electric lighting plant, was carried by yeas 1,878 to nays 1,397. The other proposition was to authorize the city council to borrow $40,000, to be used in constructing such plant, or for the purpose of lighting the city with electric lights or otherwise, through a contract, and this proposition also carried, yeas, 1,868, nays, 1,419. We are informed by the city clerk that he is unable as yet to give any information as to the probable final action, on either proposition, that will be taken by the city council.

THE ELECTRIC RAILWAY.

CATLETTSBURG, KY.—Work is to be at once commenced on the electric railroad.

VANCOUVER, B. C.—The electric street railway and lighting system at this place has been sold to an Enlgish company for $350,000.

SAGINAW, MICH.—The Saginaw street car line has been sold to the Union Street Railway Company electric line and will also be equipped with electricity.

TONAWANDA, N. Y.—A plan is said to be on foot to connect Lake Erie with Lake Ontario by an electric road by way of Tonawanda, Lewiston and Youngstown.

NEW ORLEANS, LA.—The stockholders of the Orleans Railroad Company have decided to equip the road with electricity and work will soon be commenced.

PORT JERVIS, N. Y.—Port Jervis will have a trolley road. The Suburban Street Railway Company has accepted the charter granted by the Board of Trustees.

CHICAGO, ILL.—The certificate of the North Side Electric Railway Company, proposing to increase the stock to $1,000,000, has been filed. A. B. Lewis is secretary.

BRISTOL, CONN.—Mr. McKenzie, of Southington, has been busy for a number of days on the survey for a new route for the tramway from Bristol to Plainville.

BALTIMORE, MD.—The Baltimore & Curtis Bay Railway, which is part of the Baltimore Traction Company's system, will be extended a distance of about one and a half miles.

WATERLOO, N. Y.—The work of building the Geneva and Waterloo electric railway is rapidly being accomplished. It is now thought that cars will be running on December 1.

BENNINGTON, VT.—The Governor has approved the bills incorperating the Bennington & Woodford Electric Railroad Company and the Bennington & Woodford Improvement Company.

NORRISTOWN, PA.—The Norristown & Perkiomen Electric Railway Company, the line of which runs from Upper Providence to Worcester, has been incorporated, with a capital of $150,000.

CHESTER, PA.—It is said that next summer will see the extension of the trolley system so that Rutledge, Morton, Folsom and Clifton Heights will be brought in close union with this city.

NEW ORLEANS, LA.—The Orleans Railway Company has decided to adopt electricity as a motive power. The estimated cost of the change is $210,000. P. Congot is president of the company.

TOWER CITY, PA.—The right of way has been granted for the construction of an electric railway through the Williams Valley, commencing at Tower City and extending through Williamstown and Lykens.

BRAZIL, IND.—An electric line is to be built to connect Brazil and Terre Haute. Max Joseph and R. J. Smith are said to be incorporators of a company for this purpose, of which the capital stock is $15,000.

WARREN, O.—Three companies are seeking to get the franchise for an electric railroad from Niles to Girard and the county commissioners will consider the applications the first Wednesday in December.

SENECA FALLS, N. Y.—A project is on foot at Seneca Falls to extend the electric road from its present terminus near Partridge block to Cayuga. Mr. Craig, a prime mover, is interested in Cayuga Lake Park.

HOBOKEN, N. J.—The Jersey City, Hoboken & Rutherford Electric Railway Company has presented its petition to the Mayor and Council of the city of Hoboken, asking a location for the tracks of its street railway.

MECHANICVILLE, N. Y.—Messrs. Powers, of Lansingburgh, have been granted a franchise by the Board of Trustees of Mechanicville, for the construction of an electric railway from Mechanicville to Stillwater.

HINGHAM, MASS.—The hearing given by the Hingham select men on the petition of the Hingham Street Railway Company for a franchise was attended by 600 citizens. The selectmen took the matter under consideration.

PEEKSKILL, N. Y.—A franchise was granted November 20 to the Peekskill, State Camp and Mohegan Railway Company for an electric road. Mr. Edward B. Gallagher, 253 Broadwey, New York, is the engineer of the company.

LAFAYETTE, IND.—Mr. E. B. Gunn, recently superintendent of overhead and underground work of the People's Traction Company, Philadelphia, has been appointed general manager of the Lafayette Street Railway Company.

CORNING, N. Y.—The following directors of the Citizens' Electric Railway Company have been elected: Arthur A. Houghton, B. W. Wellington, Col. John Magee and Frank D. Kingsbury. It is now thought the railway will be built.

EAST STROUDSBURG, PA.—East Stroudsburg's Council does not intend to pass an ordinance giving the Delaware Valley Electric Railway right-of-way through the streets without giving the various sections thorough consideration.

NORTHAMPTON, MASS.—The directors of the Northampton Street Railway Company voted to build the proposed street car line to Easthampton through the meadows. It is understood that the work will be commenced in the spring.

NASHUA, N. H.—At a meeting of the Board of Aldermen a petition was presented by the Nashua Street Railway Company asking the right to use electricity as a motive power, and to erect poles in the streets for the necessary wires.

WARREN, O.—A movement has been inaugurated looking to the connection of Youngstown and Warren by an electric railway, and an application has been made to the commissioners for a franchise from Youngstown to Niles by way of Girard.

BROOKLYN, N. Y.—A rumor has gained credence that the Prospect Park & Coney Island Railway, running from Ninth avenue and Twentieth streets and from Thirtieth street and Fifth avenue to Coney Island, will change its system to the trolley.

ATLANTA, GA.—The City Council has extended until February 5, 1895, the franchise granting the Lithia Springs Electric Railway Company authority to build its lines into the city. B. F. Curtis is vice-president and general manager of the company.

OSWEGO, N. Y.—The Oswego Street Railway Company has made applicaton to the Common Council of the City of Oswego for permission to extend its line as now constructed and operated, in and upon certain streets of the city. Fred. D. Wheeler is city clerk.

TUNKHANNOCK, PA.—Lake Winola people are speculating upon the chances of an electric line from Coton to Tunkhannock, via the lake. They would have it to take in Newton Center and the other little hamlets down that way, and claim the route is feasible.

SALINA, KAS.—The bonus given L. M. Erb, of Leavenworth, for the construction of an electric street railway in this city has at last been fully secured by the committee. Mr. Erb pronounced everything all right, and will start work as soon as the franchise is granted.

KANSAS CITY, MO.—The motive power of the Broadway Line will be changed to electricity. The Metropolitan Company will ask for franchises as soon as the property owners have given their consent. Electricity will be furnished from the Metropolitan power house.

ANNAPOLIS, MD.—The directors of the Annapolis and Bay Ridge Electric Railway held a meeting to consider propositions of surveying the route of the proposed road. Several propositions were submitted by contractors to build the road. Mr. C. Musgrove presided at the meeting.

ALBANY, N. Y.—A project is on foot to unite Albany and Castleton with an electric railway for local trade. The proposed railway will go through Greenbush and down the river road. A preliminary meeting will be held. Some of the friends of the scheme favor an extension to Troy.

CLEVELAND, O.—F. A. Sieberling and an Akron syndicate have been granted a franchise by the County Commissioners to build and operate an electric railway along the improved Bedford road. The franchise is for 25 years, and in return for the grant the county will receive an annual payment of $300.

CORNING, N. Y.—The Citizens' Electric Street Railway Company, of Corning, has been reorganized with a board of directors as follows: B. W. Wellington, John Magee, and A. A. Houghton, all of that city. It is the intention of this new board to push the street railway project in that city as rapidly as possible.

OSWEGO, N. Y.—Some of the property owners living on the proposed lines of the street railway extensions object to the road going into their streets. The Street Railroad Company expects to be able to get the necessary consents to insure them the right-of-way, and believe the Council will grant them the franchise petitioned for.

CARTHAGE, MO.—The Jasper County Electric Railway Company has been incorporated with a capital stock of $50,000. John W. Halliburton, Samuel Reynolds, Isaac Perkins and others are interested. The object is to construct an electric railway from Carthage to Cartersville, Webb City and Joplin, a distance of 15 miles.

SAGINAW, MICH.—The Saginaw Consolidated Street Railway Company, which was organized some time ago with a capital of $150,000, has consolidated with the Riverside Park Railway. The plant, franchise and rights of the City of Saginaw line, one of the oldest in the State, have passed into the hands of the consolidated company.

SAGINAW, MICH.—The old horse car lines of the city, known as the City of Saginaw Railroad, at the head of which was ex-Governor Jerome, were sold to the Union Street Railway Company electric line, and will be equipped with electricity. All the street car lines of the city will now be under one arrangement, with Detroit men at the head.

OTTAWA, CANADA.—It is said Messrs. Joseph Tait and John Flett, of Toronto; L. C. Raymond, Welland, and others, are seeking incorporation as the Niagara River Tramway Company, to build and operate a cable tramway over the Niagara river. The headquarters of the company is to be at Niagara Falls, and the capital stock is placed at $40,000.

McKEESPORT, PA.—The Second Avenue Traction Company is the syndicate formed by the consolidation of the Reilly-Burns-Callery electric lines, running from Coraopolis to Braddock. This syndicate has, it is understood, purchased the Homestead Electric Street Railway Company's line on the west side of the Monongahela River, and will extend it to McKeesport, crossing to the east side of Glenwood.

NEWPORT, L. I., N. Y.—The project of establishing electric railway communications across Long Island, making Northport, on the north side, and Amityville, on the south side, terminal points, is receiving further attention, and it is not unlikely that the enterprise will at an early date receive a favorable impetus. The construction of a large and complete electric light plant at Northport is contemplated.

NORWAY, ME.—A new electric road, soon to be constructed, will be the Norway & Paris Street Railway. It will extend from South Norway, Paris, to Norway, a distance of two miles. The capital stock is $25,000, and the road is to be commenced in the spring. The directors are George L. Beal, Norway; Freeland Howe, Norway; John F. Hill, Augusta; H. L. Shepherd, Rockport; Geo. E. Macomber, Augusta.

WESTPORT, CONN.—It is said that Frances W. Marsh, of Bridgeport, Chas. Fable, F. D. Ruland, M. D., W. E. Osborne and Chas. Harris of Westport, have given notice that they will petition the coming legislature to incorporate them as the Westport & Southport Trammay Company, to build a trolley line from Lyons Plains in Weston to Westport, Cedar Point and Saugatuck, terminating at the New Haven railroad depot.

SOUTH BOUND BROOK, N. J.—The New York & Philadelphia Traction Company has asked the Board of Street Commissioners of South Bound Brook, Somerset County, for permission to construct, operate and maintain a street railroad, with one or more tracks and necessary turnouts, to be operated by electricity or other motive power except steam, and to erect conduits and wires, power plant and necessary poles, in certain streets of the city.

ELMIRA, N. Y.—It is said a project is on foot to connect Elmira and Waverly with an electric line, the tracks to follow the river road. The projectors of the enterprise are said to be stockholders of the Waverly, Sayre & Athens line. They believe Elmira would be an important terminus for their road, and by next spring it is rumored that if the right-of-way can be secured and contracts entered into with the E. & H. Co., whose lines they will tap at Maple avenue, actual work will be begun.

WASHINGTON, D. C.—Bids have been invited for building 16 miles of double track electric railroad from Washington to Laurel, Md., for the Washington & Baltimore Boulevard Company. The bids are to be opened the first week in December at the office of the president, David M. Newbold, of Baltimore. The specifications provide that the road shall be laid with 80-pound steel rails, and shall be so ballasted and constructed as to permit electric trains to attain a speed of 60 miles an hour. Three steel bridges, one of 100 feet and two of 50 feet, are also included in the specifications.

Personal Notes.

THE ANCHOR ELECTRIC COMPANY, of Boston, the newly organized electrical supply establishment of that city, and succeeding the Brown Electric Company and the supply business of the Hawks Electric Company and the Iona Manufacturing Company, possesses an executive staff which should certainly secure for it a strong business foothold and successful future. Mr. H. C. Hawks, its president, was born in Deerfield, Mass., in 1862. His early education was obtained in the public schools of that town, and in the year 1883 he entered the Worcester (Mass.) Polytechnic Institute, from which he graduated S. B. in civil engineering in the class of 1886. In the same year he commenced his business career in the engineering department of the Chicago, Burlington & Quincy Railroad at Chicago. In the spring of 1887 he became identified with the engineering department of the Atchison, Topeka & Santa Fe Road, and in the fall of that year associated himself with the Marr Construction Company of Pittsburg, a corporation occupying a prominent position in the field of electrical construction. This was the commencement of the electrical career of Mr. Hawks. Until the spring of 1889 he was engaged in superintending important electrical installations for this company in the west and south. In the spring of 1889 he became connected with the Boston office of this company, with which he was identified until it was absorbed by the North American Construction Company, of which he was made New England manager. He continued in this capacity until the early part of 1892, when, upon the company deciding to give up business, he purchased its New England business and conduc-

H. C. HAWKS

NORMAN MARSHALL

P. M. REYNOLDS.

ed the same on his personal account for about a year. In 1893 he organized the Hawks Electric Company, of which he became treasurer and general manager, securing for it liberal and profitable business recognition in the form of construction work and electrical supplies. He remained with this company until the formation of the Anchor Electric Company. In the line of electrical construction Mr. Hawks has superintended the installation of about 75 lighting and power plants in New England alone, to say nothing of others distributed throughout the country and all of which have earned for him an enviable reputation. It may be said of him that he is thorough in everything that he does and careful and painstaking almost to the extreme, qualities which have won success for him in the past and which will unquestionably tell greatly to the benefit of the Anchor Electric Company. Mr. Norman Marshall, vice-president and secretary, was born in Hampstead, N. H., in 1864. In 1870 his parents removed to Howard, Mass. a small country village, and until he was 16 years of age his life was divided between the country school and the farm. His first business experience was in the office of an architect and civil engineer, a profession for which he had manifested a preference. He finally entered the Worcester (Mass.) Polytechnic Institute, from which he graduated S. B. civil engineer in 1886. Like Mr. Hawks, he also became identified at once with the Marr Construction Company, and during his connection with it assisted in the construction of some of the first Edison central stations built, becoming ultimately a superintendent of the company and having charge of several notable plants in the west and south, those worthy of special mention being located at Altoona, Pa., Dayton, O., Birmingham, Ala., and Fort Worth, Gainesville, Marshall and Houston, Texas. Returning from Texas in 1889 Mr. Marshall was assigned to the Boston office of the Marr Construction Company, and when it was merged into the North American Construction Company he decided to enter into the manufacture of electrical specialties, and located in Philadelphia, where he remained until the spring of 1892, when he returned to Boston and formed the Iona Manufacturing Company, the success of which is so well known as to require no special mention, and the same energy which obtained this success, will, without the saying, be exerted to push forward the Anchor Electric Company. Mr. P. M. Reynolds, treasurer, was born at Nahant, Mass., in 1868. He was given an excellent common school education, after which he entered at Harvard and from which he was graduated in 1889. He was attracted at once to the business possibilities in the electrical industry and entered the factory of the Thomson-Houston Company, remaining there for six months, familiarizing himself with the manufacture of electrical apparatus, after which he connected himself with the mining and motor department of the company, performing expert work for about a year in mines all the way from Pennsylvania to Utah, returning finally to the Boston office in the capacity of salesman. In the fall of 1893 Mr. Reynolds resigned the position to become treasurer of the Brown Electric Company, a position he was in every respect competent to fill, and the experience gained with this company, added to his general electrical knowledge, should eminently fit him for the position he occupies with he Anchor Electric Company.

Trade and Industrial Notes.

THE LE ROY HYDRAULIC ELECTRIC COMPANY, Le Roy, N. Y., is constructing a building at the plant north of the village, in which will be placed a 75-hp boiler and engine.

THE MASCHINENFABRIK OERLIKON, Oerlikon bei Zurich, has obtained at the international exhibitions of Lyons and Antwerp of this year the highest award, the "Grand Prix," for eminent work in the line of electrical industry.

MR. ADDISON G. WATERHOUSE, the well known inventor of the Waterhouse Arc Lamp and Arc System, who has recently returned from Europe, is now connected with the Mather Electric Company, at their works at Manchester, Conn.

THE BUNCH & YATES COMPANY, Memphis, Tenn., recently closed contracts for four saw mill plants. Owing to the reduction of insurance that follows the installation of an electric lighting plant, their use is extending in saw-mills of the South, the cost of operation being practically nothing.

THE OLIN GAS ENGINE COMPANY, Perry and Chicago streets, Buffalo, N. Y., in a recent catalogue describes its new pattern of gas engine especially adapted for electric light plants. The pamphlet contains considerable information relating to gas engine electric plants and will prove interesting reading to those interested.

THE SHEDLOCK AUTOMATIC BRAKE COMPANY has been incorporated, and will make Jersey City, N. J., its place of business. The capital stock is $250,000. The company will manufacture brakes for steam, electric and cable cars. The incorporators are Alfred Shedlock, of Jersey City, Wm. H. Forster of Elizabeth, and others.

THE ELECTRIC ENGINEERING & SUPPLY COMPANY, Syracuse, N. Y., has opened an office in the Electrical Exchange Building, at 136 Liberty street, Room 315, with F. M. Hawkins in charge. It has also opened a store room at 132 Washington street where will be kept a sufficient line of stock on hand to meet the wants of New York customers.

J. H. BUNNELL & COMPANY, 76 Cortlandt street, New York, have issued a new edition of their familar catalogue, the present one containing 225 pages and nearly 750 illustrations. As every one knows "Bunnell's catalogue" it would be superfluous to describe it, and we will merely say that it is thoroughly up to date, with considerable additions in various departments, particularly electric lighting.

THE SPERRY ELECTRIC RAILWAY COMPANY, Cleveland, O., in a handsome 38-page catalogue describe and illustrate the Sperry Street Railway system, including the electric brake recently introduced to the electrical public through a paper read before the American Institute of Electrical Engineers The numerous half-tone illustrations throughout the pamphlet enable the various details of the system to be easily understood, while the text brings out very full, the points of superiority claimed for it.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., makers of the well known lava electric insulators, reports a gratifying revival in its business and its orders are more frequent and much larger than some time ago. Its insulators are equally good for interior or exterior work, overhead, underground or under water, and it is claimed will stand a greater heat than anything else known. Its insulators have been extensively used by leading electrical manufacturing companies.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., reports that the excessively heavy demand for "O. K." weather proof wire during the past few months has taxed its ability to keep up its stock, and as each car load is received it seems to melt away before it can be placed in position in the stock room. New arrangements have just been completed to obviate any delay in filling orders, and the company therefore assures its customers that in a few weeks it will be in a position to fill more promptly orders from its Chicago stock.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has just completed for the Baldwin Locomotive Works, of Philadelphia, Pa., steel roof trusses for the addition to their wheel shop. The same company will also furnish the new power station for the United Electric Light & Power Company, on East 28th street, New York city. The power house is 100 feet wide and 200 feet long; the engine room is 100 feet wide and 80 feet long, and the boiler room is 56 feet wide and 100 feet long. The coal pockets in the boiler room have a capacity of 3,000 tons.

MR. E. H. JOHNSON, of the Interior Conduit & Insulation Company, 44 Broad street, New York, very generously disclaims what he considers undue credit given him in the article in our columns last week descriptive of a new service end cut-out. In a letter to us he states: "In your illustration and description of Mr. Van Vleck's 'Service End Cut-Out' there appears too much Johnson, and too little Van Vleck. I am not the father of that baby; my only relation to it in fact is a sort of cousinship in that Mr. Van Vleck has married his invention to the Johnson Vise Lock Switch. Kindly correct the injustice done to a worthy parent of a worthy child."

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., have just concluded arrangements with Manning, Maxwell and Moore, of New York, and the Niles Tool Works, of Hamilton, Ohio, for a large amount of new machine tools, which will be installed in the Manchester plant at once, and which are especially adapted for the building of large direct connected and belted generators which the Mather Company are now making quite a specialty of. The plant at Manchester has been running over-time with full force for the last two months and the company now has orders on hand to keep its entire plant busy from four to five months.

EDWARD F. AUSTIN, 95 Fifth avenue, Pittsburg, Pa., who before the assignment of the Altoona Manufacturing Company, was its efficient sales agent of the Pittsburg district, has taken charge of the Pittsburg office of the Phœnix Iron Works Company, of Meadville, Pa., manufacturers of the well known Dick & Church engines, boilers, feed water heaters, etc. Mr. Austin reports the sale of a 15x18 engine to Jones & Laughlin, and three 100-hp. boilers for the Schenley Park Casino; these boilers are particularly designed for safety, etc., and are of special make all through. He also reports several smaller sales and states that inquiry is increasing from all localities and that he looks forward to an increase of trade in the boiler and engine business.

H. D. BAYNE & COMPANY, Mutual Life Building, New York, whose organization was reported in our issue of November 17th last, have just received the appointment from the Campbell & Zell Company, of Baltimore, Md., as its managers for the States of New York and New Jersey. This will open up to the firm a large field for their activity in the selling of the Zell Patent Safety Water Tube Boiler, which has earned for itself an enviable record for efficiency and economy as a steam producer, as well as for absolute safety, simplicity of construction and superiority of workmanship. The firm will be glad to receive inquiries from intending purchasers of boiler plants, and have at their disposal an interesting catalogue, and some other useful literature to steam users.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in order to properly take care of its increased transformer business, is making an addition to its factory. The transformer department has been running three nights in a week, in an endeavor to keep ahead of orders. With increased floor space the facilities for manufacturing transformers will be greatly increased, and the company then will be able to take care of promptly and ship from stock any reasonable sized order they are favored with. Among some very large orders, recently booked, was one from the La Roche Electric Works, for its new plant at Atchison, Kansas. An office was opened Nov. 12th, at 15 Federal street, in Boston, with R. O. Hood, late of the General Electric Company's meter and transformer department in charge.

ELMER G. WILLYOUNG & COMPANY, through Mr. Elmer G. Willyoung, who has just returned from a two months' visit to England, have consummated arrangements for acting as the sole American agent for Messrs. Nalder Bros. & Company, London, the largest manufactures of electrical instrruments of precision in the world. He will also act as the agent for James White, Glasgow, Scotland, maker of Sir Wm. Thomson's balances and electrostatic measuring instruments, and for L. Oertling, London, analytical and assay balances. Arrangements have also been made with other foreign firms to import apparatus at most advantageous rates, and to have any instruments which may be damaged in the transit, repaired by experienced workmen, under the personal supervision of Mr. Willyoung. It is the intention of Nalder Bros. & Company and James White to make as rapidly as possible, such modifications in the design of their instruments, as shall better adapt them to the needs of American users, and new instruments, especially fitted for American practice, will be designed and brought out as rapidly as possible. Mr. Clayton W. Pike, formerly of Queen & Company, will be associated with Mr. Willyoung. Mr. Pike was in charge of all the Worlds' Fair exhibits of Queen & Company, and has a very extensive acquaintance among the colleges and technical schools, having personally visited nearly all of them, during the year previous to the World's Fair, for the purpose of obtaining a better acquaintance with their requirements.

Business Notices

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs, doing business at Rochester, N. Y., has been mutually dissolved.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 20, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

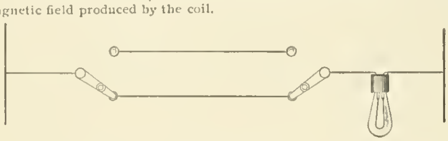
529,354. CONTACT DEVICE FOR OVERHEAD ELECTRIC RAILWAYS; J. L. Blackwell, New York, N. Y. Application filed September 15, 1888. The combination of a rod having a hollow end, a piston carrying a contact piece and forced by spring pressure against the supply wire, and a cord attached to the piston leading to a fixed point of the vehicle.

529,373. ELECTROMAGNETIC APPARATUS; S. D. Field, Stockbridge, Mass. Application filed July 24, 1894. A polarized induction coil having both poles of the inducting medium inclosed within the primary and placed outside of the secondary circuit.

529,385. ELECTRIC FAN MOTOR; F. X. Hofbauer, Newark, N. J. Application filed August 1, 1894. This comprises a field magnet consisting of a permanent magnet having upwardly extending poles and constituting an extension of the standard or support.

529,398. AUDIBLE SYNCHRONISM INDICATOR; R. D. Mershon, Pittsburg, Pa. Application filed April 27, 1894. This comprises a polarized diaphragm, a magnetic core presenting two poles thereto and two coils connected with the terminals of the machines to be synchronized, each of the coils producing one of the actuating poles.

529,399. AUDIBLE SYNCHRONISM INDICATOR; R. D. Mershon, Pittsburg, Pa. Application filed April 27, 1894. This comprises a coil in series with the two machines to be synchronized and a vibrating body actuated by the magnetic field produced by the coil.



No. 529,532.—SWITCHING APPARATUS FOR INCANDESCENT ELECTRIC LAMPS.

529,406. UNDERGROUND ELECTRIC RAILWAY. H. B. Nichols and F. H. Lincoln, Philadelphia, Pa. Application filed June 13, 1894. This comprises a road bed, track, rails and frames, the latter reversibly arranged to constitute a slotted contracted chamber communicating with an enlarged lower chamber, racks supporting supply or feeder wires and an electric conductor in the lower chamber supported by insulated cross guys to the structure out of alignment with the slot of the contracted chamber.

529,411. MANUFACTURE OF ELECTRIC CONDUCTORS. J. Robinson, Philadelphia, Pa. Application filed February 16, 1894. This comprises a carding engine with a wiper, a jacketed tank provided with a revoluble roll, a nozzle a rotatable whirler, a tank for containing insulating material and a winding reel.

529,412. INSULATED ELECTRIC CONDUCTOR; J. Robinson, Philadelphia, Pa. Application filed February 17, 1894. A wire provided with an insulating coating having a smooth surfaced covering of cotton thereon a binder of cords in regular sequence wound around the same, and a coating of insulating material permeating the body of the covered wire.

529,413. MANUFACTURE OF ELECTRIC CONDUCTORS; J. Robinson, Philadelphia, Pa. Application filed March 6, 1894. This consists in rotating and drawing a wire through a bath of insulating material, feeding, and while the wire is still moist applying and compacting cotton under tension, to form a binder therefor.

529,421. MULTIPLE SWITCHBOARD SYSTEM; C. E. Scribner, Chicago, Ill. Application filed May 1, 1890. The combination with a pair of plugs and cords, of a cord switch consisting of a frame having a socket for one of the plugs, a pair of springs in a branch from the cords through a telephone and a battery to ground, and a plunger mounted on a pivoted guide provided with an arm and contact springs operated by forcing down the plunger.

529,429. ELECTRIC INCANDESCENT LAMP; E. Thompson, Swampscott, and E. W. Rice, Jr., Lynn, Mass. Application filed February 8, 1892. The combination with a plurality of multiphase circuits, of a plurality of incandescent lamp filaments having separate connections to the circuits and to a common return, a reactive coil in the return, and a circuit controlling devices for all of the connections.

529,433. ELECTRICAL MEASURING INSTRUMENT FOR SWITCHBOARDS; J. Van Vleck, New York, N. Y. Application filed April 14, 1894. This comprises an inclosing case provided with an external periphery of less width than the sides of the case, a scale on the periphery and a pointer or index moving over the scale.

529,434. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. Application filed October 3, 1892. This comprising a vibrating lever, a coil supported on one arm thereof, a means of equilibrating the coil and a fixed coil disposed in a plane parallel to that of the movable coil when the movable coil is in a normal position and a spring opposing the vibratory movement of the lever.

529,435. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. Application filed June 21, 1894. A case formed of two separable parts, one part consisting of a side plate and flange, and the other of a side plate and flanges in combination with a rack secured on the exterior of the flange.

529,437. ARMATURE CORE; J. J. Wood, Fort Wayne, Ind. Application filed August 21, 1894. A sheet iron blank for an armature core, consisting of a segment of the core having on its inner side overhanging hooks for embracing the fastening bolts.

529,451. COMBINATION GAS AND ELECTRIC LIGHT FIXTURE; G. A. Loeben, Philadelphia, Pa. Application filed June 7, 1894. This comprises a tapered key, and arranged to be secured to the upper portion of the joint by a clamping screw, and provided with vertical and transverse passages, and having an externally threaded opening near its middle.

529,461. METHOD OF AND MEANS FOR SYNCHRONIZING ALTERNATING CURRENT MOTORS AND GENERATORS; H. N. Potter, Allegheny, Pa. Application filed May 3, 1894. This comprises a diaphragm, a magnetic core presenting a single motor-pole thereto, and two coils connecting to the terminals of the machines to be synchronized, the coils being so wound on the cores as to produce a resultant effect at the motor pole.

529,465. TELEPHONE SYSTEM; J. I. Sabin, San Francisco, Cal. Application filed June 14, 1894. This comprises a contact arm adapted to be moved over a series of terminals of an electro-magnet, a disk rotatable with the contact arm, a spring carried upon the polarized armature of an electromagnet, and means for reversing the direction of current through the magnet to cause the first named magnet to be shunted.

529,484. PRINTING TELEGRAPH; B. A. Fiske, U. S. Navy. Application filed October 13, 1888. This comprises a shaft, a type wheel connected thereto, arms loosely mounted upon the shaft, a latch, adjuster magnet, and a curved extension of the armature lever of the magnet.

529,532. SWITCHING APPARATUS FOR INCANDESCENT ELECTRIC LAMPS; C. E. Scribner, Chicago, Ill. Application filed April 3, 1889. This comprises a translating device, a pair of switches, each provided with two contact points united by circuit connections, movable contact making members adapted to close circuit through the contact points, the members being connected respectively directly to the opposite mains of the source of electricity.

529,552. TROLLEY STAND; F. N. Kelsey, New Haven, Conn. Application filed August 29, 1894. The combination with a pivotally supported socket piece for receiving the trolley arm, of a spring actuated controlling device which engages a portion of the socket piece and is eccentric to the path of movement of the part which it engages.

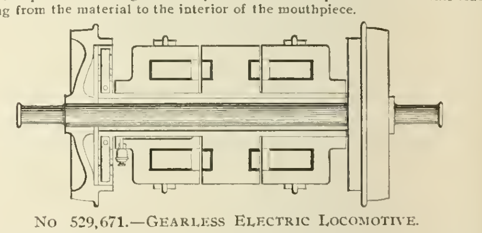
529,559. ELECTRIC CIRCUIT; J. W. Marsh, Pittsburg, Pa. Application filed April 10, 1894. This consists of a pair of conductors, one conductor having a water-proof insulation and the other conductor a non-waterproof insulation of lower specified inductive capacity, the separately insulated conductors lying side by side, whereby the conductors are separated by both insulations.

529,563. APPARATUS FOR GENERATING ELECTRICITY FOR LIGHTING RAILWAY CARS; T. A. Murray, Boston, Mass. Application filed May 3, 1894. The combination with a dynamo located below the car body, of a support for the dynamo located below and separated from the car body and mounted to be turned in a substantially vertical plane.

529,578. SWITCH; F. B. Badt, Chicago, Ill. Application filed October 14, 1892. This comprises an air-tight chamber, terminals therein, and a conducting fluid in the chamber adapted to cover both terminals when the chamber is swung in a determined position.

529,595. ELECTRIC SWITCH AND CUT-OUT. J. C. Cassidy, East Orange, N. J. Application filed September 24, 1894. This comprises a frame having an insulating block provided with a contact face thereon, and a revolving wheel having contact springs adapted to make contact with the contact face when the wheel is rotated.

529,609. ANTISEPTIC MOUTHPIECE FOR TELEPHONES; R. N. Dennison and F. M. Geary, Brooklyn, N. Y. Application filed April 25, 1894. A mouthpiece containing an antiseptic material and provided with vents leading from the material to the interior of the mouthpiece.



No 529,671.—GEARLESS ELECTRIC LOCOMOTIVE.

529,616. SECTION INSULATOR; A. Hennefeld, C. Dehner and C. H. Van Ness, Colorado Springs, Col. Application filed April 19, 1894. The combination of a curved bar of insulating material provided with metallic tips, a perforated insulating bar secured to the main bar and adapted to receive loops formed on the ends of the trolley wire, clamping plates for holding the wire in place in the bar, and clamps for fastening the loops at the end of the trolley wire.

529,630. PRINTING TELEGRAPH; G. A. Scott, London, England. Application filed September 6, 1887. The combination of a type wheel, a flexible connection connected to the type wheel to operate the same, a securing device for one end of the flexible connection, and a series of magnets the armatures of which operate upon the flexible connection to move the type wheel.

529,650. CONTINUOUS CURRENT DYNAMO ELECTRIC MACHINE; M. Hutin and M. Leblanc, Paris, France. Application filed February 12, 1894. A dynamo provided with one or more electrical circuits of low resistance, closed upon themselves and threading through the polar extensions of the field magnets.

529,654. ELECTRIC LIGHT FIXTURE; J. R. Konetshny, Brooklyn, N. Y. Application filed February 21, 1894. This comprises a lamp base, automatic reel secured within the base, flexible conductors passing around the reel and through an aperture in the base, and connected at their free ends with the lamp, together with a lamp holder attached to the lamp, the lamp holder being separable from the base and arranged to fit over and embrace the base carrying the reel.

529,671. GEARLESS ELECTRIC LOCOMOTIVE; C. J. Van Depoele, Lynn, Mass. Application filed June 3, 1891. An electric motor for cars mounted upon a sleeve surrounding the axle and sustained by springs secured to the wheels.

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CONTENTS.

ELECTRICAL ENERGY DIRECT FROM COAL.

Heat is a very good thing in its place but very objectionable when out of place; it is not surprising therefore that while some engineers are trying to get as much heat out of coal as possible others are trying equally hard, if not harder, to get as little heat as possible. A few weeks ago we called special attention to some recent interesting develoments in one of the two problems of the day, the production of light without unnecessary heat, and in the present issue some interesting figures and suggestions are given in an article abstracted in the Digest regarding the other of the two problems of the day, the production of electricity from coal also without unnecessary heat. The possibilities in the former are that from 20 to perhaps 250 times as much light may be obtained per watt than at present, the figures differing with different authorities, one giving even a very much greater possible increase; the possibilities in the other problem are known more definitely and show that we can obtain nine or ten times as much electrical energy from coal as at present obtained by what are called good steam engines or boilers, good in construction but very poor in principle. If both of these limits are reached, the results will certainly be startling, but at the same time they should not be overestimated. There are three factors in the cost of light, the fuel, the labor and the capital, the first of which is smaller than is often supposed; assuming that the other two are not increased or diminished by a very much more efficient method of generating electrical energy from coal or light from electrical enegry, or both, then the effect of such an improvement on the cost of light will be but small. Unless, therefore, such improvements also diminish the cost of labor and capital per candle-power hour, they will be chiefly of scientific rather than of practical interest, at least as long as coal is cheap. The experiment alluded to above showed an efficiency which is already three or four times better than that obtained by the steam engine. A curious feature in the production of electric energy directly from coal, is the possibility of obtaining even more than 100 per cent. on a somewhat similar principle as that suggested in an interesting and classic paper by Lord Kelvin,—then Prof. Thomson—read before the Physical Society of Glasgow in 1852, namely, by obtaining in addition some of the energy residing in the heat of the surrounding air, which heat costs absolutely nothing. We have several times called attention to a battery constructed on this principle, which shows that it is possible to convert the heat of the air directly into electrical energy. There are a number of ways in which the problem of obtaining electrical energy from coal can be attacked, some direct and some indirect, and although owners of central stations and purchasers of electrical plants need not have any fear that the present machinery will soon be useless, yet from the attention given this subject at present it is not at all unlikely that some results of practical value will be reached before many years; they need be only very poor to exceed those obtained by the steam engine.

ANOTHER ELECTRICAL THEORY.

We have frequently referred in these columns to the quantities of pseudo-theories with which the public is favored through the non-scientific press, and which has resulted in bringing the word "theory" into popular disfavor. A recent and amusing instance of one of these is from the pen of a writer who approvingly quotes the opinion of a friend to the effect that he posseses a genius for physical research and should spread the light of his undesrtanding abroad, who intimates to the reader that his grasp of first principles is intuitive, and informs them that until four years ago he had no knowledge of mechanics

of any sort and had given no attention whatever to science. With this introduction we will permit our theorist to proceed. "It is my "belief that sooner or later some naturally gifted man will conceive "and understand the natural power and will be able to transmit "electrical effects from the earth's currents into the universal vac-"uum, and thereby communicate with other spheres—at any rate "facts instead of theories will be known of this great natural power. "How is it possible for those to reproduce or direct a complete power, "when, as I notice in a pamphlet describing an electric motor, they "say that 'the elements employed in the cell are zinc, from which "the negative current is obtained, and the positive current from "black oxide of copper.' Copper is not positive, nor is zinc negative "but just the contrary. Copper is a negative material and zinc is a "positive material matter, which means that copper as a material "matter influences and adheres to say 90 per cent negative (fem-"inine) current and probably loses 10 per cent. of the positive "(masculine) current, thus being a negative material matter (fem-"inine), or a gentle or softer metal. Zinc as a material matter "influences and adheres to say 90 per cent. posiitve (masculine) "current and probably 10 per cent. negative (feminine) current; "thus certainly it is a positive (masculine) or a sterner or harder "metal; in the same manner as with mankind and animals."

THE NATIONAL SCHOOL OF ELECTRICITY.

The numerous inquiries we have received from readers in regard to the National School of Electricity, seem to indicate that those in charge have not been eminently successful in imparting a clear understanding of the methods and object of that enterprise. The misconception that prevails we believe to be largely due to the ambiguity that exists as to the real function of the so-called faculty; to the implied claim that philanthropy forms the basis of the undertaking, and to a lack of definition of its object; a frank statement on these points from the managers of the school would go far towards relieving it from the suspicion that seems now to exist in some quarters as to its real character. We believe that a useful purpose may be accomplished by a system of elementary instruction organized somewhat after the lines of the Chautauqua course, with the addition of a more practical element for the benefit of those engaged in electrical pursuits who have not had the advantage of instruction in electrical principles. The interest displayed in the University extension courses conducted this spring in New York under the auspices of Columbia College, and in the several similar electrical courses now running in New York and Brooklyn, show that there exists a lively desire to gain electrical knowledge, and we believe that in every city and town where there are a sufficient number connected with electrical pursuits a similar interest exists that might be usefully catered to. We do not consider, however, that such a course of instruction can accomplish much more than to teach the elementary principles and the broad outlines of electrical science. It may impart the general knowledge that amateurs and others desire, and teach those engaged in electrical callings the points of theory they lack, and whose acquisition will give them a firmer grasp in dealing with their everyday work; but it will not make electricians and engineers, though the vague promises contained in the circular of the school in question may be construed into a claim to this effect. We are not aware that any direct claim of philanthropy has been made by the managers of the National School of Electricity, but, judging from newspaper clippings, some of its agents have conveyed this impression, which has an apparent basis in the undoubted disinterested motives of the auxiliary "faculty." If the object is a philanthropic one, a direct statement to that effect should be made, accompanied with an explanation of the disposition of the considerable sums of money which would accrue if the school were as successful as designed. If, on the other hand, the enterprise is a purely commercial one we cannot see why this should not be frankly avowed, for there would be no discredit attached that we can see. Another explanation due to those who are asked to subscribe to the course is the real function of the "faculty." It has been stated, without contradiction that we know of, that two members of this body have repudiated, as far as refers to them, the statement that the "faculty" takes an active part in the preparation of the courses; and we note that the lesson sheets have no signatures. As the managers of the school, as far as we are aware, do not claim any reputation either as electrical engineers or as teachers, the reputation of the other members of the "faculty" is that upon which success depends, and it is simply a matter of fair dealing to give assurance that the confidence which may have been thus inspired is not misplaced. If the points to which we have referred are satisfactorily cleared up, and the school is conducted in the straightforward and open manner which we feel sure is the earnest desire of the highly respected gentlemen whose names have been its stock in trade, it may accomplish a very useful purpose even if it does not extend to the making of electricians and engineers. Under its present management, if satisfactory assurances can be obtained that all the courses and lesson sheets have been prepared by members of the "faculty," and if the local instructor is a competent man, we see no reason why the advantages thus offered should not be accepted by those who desire to obtain general ideas on electrical science, or who wish to supplement their practical experience with a knowledge of the simpler points of electrical theory.

The Bate Refrigerator Case.

Through the courtesy of Charles L. Sturtevant, Esq., of the Washington patent bar, we are enabled to present a resume of the closing argument in the Bate Refrigerator case. Mr. Carter, who was the last counsel heard, went especially into the interpretation of the statute based upon the report of the Committee of the Congress which passed the law at issue. He laid great stress upon the fact that the duty of the House Committee on Patents in that Congress was merely to report to the House a revision of the patent laws as they existed at that time, and contended that, while it was a bill to amend as well as to revise, they distinguished between what was technical revision and consolidation and what was amendment, and informed Congress that both they (the revisors) and the general committtee on revision vouched for the revision as an accurate reproduction of the existing law without change. He particularly called the court's attention to the fact that Mr. Jenckes. a very able patent lawyer of his time, and Chairman of the Committee on Patents, stated that it was not necessary to read the bill in full, but that the House might safely confine its attention to the features and passages which were pointed out by the printed document as amendments. He quoted from the report of the Committee on Patents, and his argument was a very elaborate and forcible one, to show that Sec. 8 of the statute of 1836, and Sec. 6 of the statute of 1839, define the class of patents which came within their scope by the application dates, and that the statute of 1870 and revised statute 4887 must refer only to inventions patented abroad before the filing of the application in this country; for the report of the Committee on Patents on the Sec. 25 of the Act of 1870 is specifically to the effect that it is a revised but a substantial reproduction of the law under the Acts of 1836 and 1839.

By way of illustrating the harm that could and does result from giving to the present statute the interpretation hitherto adopted by the Circuit Courts, he referred to provisions of Sec. 4915 which allow the unsuccessful applicant for a patent to seek protection by a bill in equity, and contended that the defendant's reading is specifically inconsistent with the course authorized by this section, for although after a long course of action the court under Sec. 4915 might grant the patent and decide that the Commissioner was wrong in not allowing it in the first instance, the time required to invoke these remedies has in law destroyed the right where the foreign patent has been applied for, and thus in effect sanctioned the wrong. Mr. Carter also referred to the practice in case of interferences, where, beside the great delay, an interference requires a disclosure to the adversary, by printed depositions, of the whole invention, while the opposing party by sending a few copies abroad can prevent foreign patents, or if they have been previously applied for he can prolong the case here until the foreign patents have come out and so curtail the American patent.

Mathematics According to a Mathematician.

Dr. Oliver Heaviside says that the best result of mathematics is to be able to do without it.

Electrical Difference of Potential—An Analogy.

BY JOHN WADDELL.

Electrical difference of potential is in many respects analogous to difference of pressure of air, and reasoning which applies in the case of the latter, is sometimes illustrative with regard to the former. Among the different methods for establishing difference of electrical potenial, is that, which is now so important commercially, the movement of a conductor across a magnetic field of force. Exactly how the electrical condition is produced by the field of force is of course unknown; but as an illustrative analogy the following has been found useful. It will naturally be borne in mind by the reader that he is dealing with an analogy merely. Suppose a box, which for the sake of definiteness, we shall assume to be twelve inches long, and half an inch in width and in depth, air tight and filled with air, to be fitted inside with an indefinitely large number of little paddles which can swing backwards and forwards in such a manner that if set in motion in one particular direction, they will propel the air (by its scooping motion, let us say) towards one end of the box, and if set in motion in the opposite direction, they will propel the air to the other end of the box; while if they are brought to rest, the air assumes and retains a uniform pressure throughout the box. We may conceive that when the box remains quiet, the paddles do not move and even that bodily movement of the box in *certain* directions, does not disturb their position, but that movement in *certain other* direction causes such oscilliations of the paddles as to produce difference of air pressure. To attain this end, a mechanism such as the following might be imagined.

Let there be two boardss, placed vertical and opposite to each other, separated by a little distance (a few inches say), suppose from the center of each square inch of the one board, a steel wire stretched straight across to the opposite board. There would thus be rows of wires running from board to board, the number of vertical and horizontal rows depending upon the width and height of the boards. With the dimensions we have adopted, it is evident that the box could be placed so as to lie horizontally between the rows of wires, and without touching them. We may assume that the box is placed with its length at right angles to the direction of the wires. Let us now consider the paddles in the box so connected with the outside, that friction across the box in one direction would give one particular movement to the paddles; while if the direction of the friction were reversed, so would likewise be the movement of the paddles. We can conceive as a means of obtaining the friction, that the steel wires are cut across, but that the ends are kept together by the elasticity of the wires, except when they are pushed asunder. If the box is moved from above downwards, causing the wires to bend and separate so as to permit its passage, friction is obtained and the paddle will be set to work in such a manner as to propel the air from *left to right* let us say. So soon as the box passes through, the wires spring back into position, and appear continuous from board to board.

Now let the box return along its path, moving consequently from below upwards; the reversal of the movement of the mechanism will propel the air from *right to left*. Any motion of the box by which the steel wires are not disturbed will produce no motion of the paddles, and, therefore, no difference of air pressure. Such for example is the case with motion in a horizontal plane between the wires. A little thought will show the reader that if the box were turned with its length vertical, motion from left to right would propel the air from above downwards, and vice versa.

In this analogy it will be readily understood that the box represents an electric conductor such as a copper bar or wire; the boards represent magnetic poles, and the steel wires magnetic lines of force, which if cut across by the conductor, cause the establishment between its ends of a difference of potential. Any motion of a copper bar in the field of force, by which the lines of force are *not* cut, produces no difference of potential in it, just as any motion of the box by which the steel wires were undisturbed, produced no difference of air pressure. Moreover, the number of lines of force cut in a given time, determines the amount of difference of potential, and the *direction* of the motion across the lines of force, determines at *which end* of the copper bar the potential will be the higher; just as in the analogous case with the air pressure. If the spectator is looking from the north pole, along the lines of force, towards the conductor, its motion will produce difference of potential *in the same sense* as was assumed for the difference of pressure in the case considered above.

Again, if the conductor cuts, not perpendicularly, but oliquely across the field of force, fewer lines will be cut, and the same thing would hold for the box, hence, in the one case, the difference of potential, in the other, the difference of pressure, between the ends, would be diminished, and in both cases according to the *cosine* law. Furthermore, if the box were longer than the width of the series of rows of wire, for instance, if the boards were only nine inches wide in the case considered above, part of its length would contribute nothing towards developing difference of pressure. So if a conducter is longer than is required to cut all the lines of force, part of its length is useless. On the other hand if there are rows of wires uncut by the box, they are valueless, and in the same manner, if there are lines of force uncut by the conductor they are wasted. These items are important in the construction of dynamos; in economical machines the endeavor is made to have as little useless wire as possible, and also to have the field of force as nearly as possible confined to the space within which the armature rotates.

As in order to move the box against the friction of the steel wires energy must be expended, so work is required to move a conductor *across* the field of force, although motion by which the lines are uncut, requires no expenditure of work.

The analogy can be followed out, in the case of motors as well as of dynamos, for it will be easily seen that, if the paddles in the box are moving, and if they are within reach of the steel wires, the box will be dragged across the space between the boards, in the direction *opposite* to that in which it would need to be moved, in order to give that particular movement to the paddles. So it is, when a conductor in which an electric current is passing, is placed free to move, in a field of force, and this reversal of motion is the underlying principle of motors. As was said at the beginning, we have been dealing with an analogy only; but the speculative may interest themselves in considering whether lines of force may not be due to some strain of the ethereal medium, similar to what would be produced by a line of particles, rotating on an axis, whose direction is that of the lines of force. In that case an electric conductor might be considered as a body, whose molecules, or their constituent atoms, might have imparted to them a peculiar motion when the conductor breaks through the medium in its strained condition; or, if the dielectric be considered as the seat of electrical phenomena, a conductor might be regarded as such an interruption in it as would permit the establishment, by the same means, of some peculiar condition at its boundary.

Typical Inventors.

Mr. Alexander Siemens in a recent address said that when he came to England in 1867 he made the acquaintance of one of his workmen, whose business it was to lacquer brass work, and who had the peculiarity of coming to his work only long enough to earn sufficient to keep him from starving; the rest of his time he devoted to the construction of a machine for generating power. He had been a lawyer in good standing in one of the minor German states; but, unluckily for him, he had a "mechanical turn of mind," which induced him to give up his practice and to come over to England, where he hoped to realize a fortune from his invention. In 1867 he assured Mr. Siemens that another fortnight's work would complete the machine, and a new era would commence in the world's history. In spite of all arguments, of all ridicule, and of all the disappointments met, he continued working at this machine until he died about two years ago without being any nearer to his goal than he was twenty years ago. Mr. Siemens read as follows, a letter received from another inventor:—"I am not a madman—I am not an inventor nor am I a mechanic—but I have been thrown amongst engines, stationary, locomotive and marine, a great deal. A simple accident has revealed to me the modus operandi by which steam can be generated with any degree of power and employed in the propulsion of vessels without the cumbrous details of boiler or steam chest, etc. I do not go to some capitalist who may rob me of the thought —nor some other who would wish to clap me into an asylum as a dangerous lunatic—but to practical engineers like yourselves, who can, if my idea is the mere dream of a fool, instantly annihilate it with practical objections. If you will permit me to call upon you, five minutes is all I want, if I cannot satisfy you that I have not wasted your time, I will submit to be kicked out of your premises."

A New Physical Journal.

According to London *Electricity*, Nov. 16, a new physical journal devoted to the subject of physics is to be started at the beginning of next year, with the well known electrical writer, Mr. James Swinburne, as its editor.

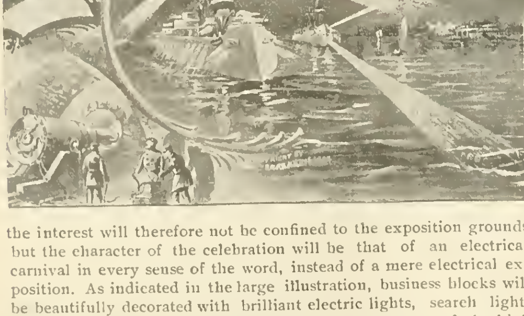
Suggestions for Buffalo's Electrical Carnival.

BY FRANK C. PERKINS.

It is hardly possible to imagine a grander sight than Buffalo might present during the coming electrical carnival—a celebration that will mark the beginning of a wonderful increase in population, wealth and industry for the electric city. Few people realize what the limits of greater Buffalo may be in the near future and the growth and advancement the city is to experience through the development and transmission of electric power from Niagara Falls. The celebration of itself cannot, therefore, be made too grand and extensive.

Manufacturers will have an opportunity to show all classes of apparatus capable of being operated by electrical energy, and every electrical attraction worthy of note should be secured and magnificent electrical displays arranged for the exposition grounds. As the whole city will undoubtedly be brilliantly illuminated and numerous novelties and electric attractions scattered througbout the city, the interest will therefore not be confined to the exposition grounds but the character of the celebration will be that of an electrical carnival in every sense of the word, instead of a mere electrical exposition. As indicated in the large illustration, business blocks will be beautifully decorated with brilliant electric lights, search lights will flash their rays from observation towers on many of the high buildings, and as the city authorities will probably co-operate with the street railway companies, the streets will be a blaze of glory.

Numerous festoons of series of five or ten incandescent lamps crossing the streets between tbe trolley wires and the iron poles which support them could be fed through current from trolley wire clamps and make a fine display. The exteriors of trolley cars might be trimmed with colored lights and produce a wonderfully pleasing effect. Many of the excursion steamers and other boats having electric plants can be brought into play and have illuminating festoons of lamps on their decks, and illuminated fleets on special evenings would make an attractive spectacle and give an object lesson as to the great extent electricity is being utilized aboard ship.

The electrical fountain is one of the most attractive and beautiful of all displays, and Buffalo sbould have several of these scattered through its parks and exposition buildings. Visitors at the Paris Crystal Palace and Chicago World's Fair will remember the fascinating charm of the beautiful effects produced by the graceful streams of water falling in rapid succession and showing all the colors of the rainbow. Several crystal fountains of colored spray surmounted by electric soap bubbles showing corruscations, stars, moons, etc., amid rocks and ferns, were features of the Cincinnati exposition that were greatly admired. Electric gardens, and magnificently illuminated flower beds, electric owls with flashing eyes of fire, magic Japanese fish, a mysterious electric fountain suspended by a single wire flashing jets of water high into the air, were some of the sources of great wonder to visitors at the Horticultural building, and Buffalo's display should not be exceeded by any of these.

The electric scenic theatre exhibited at Chicago should be reproduced and thus delight thousands who were unable to attend the

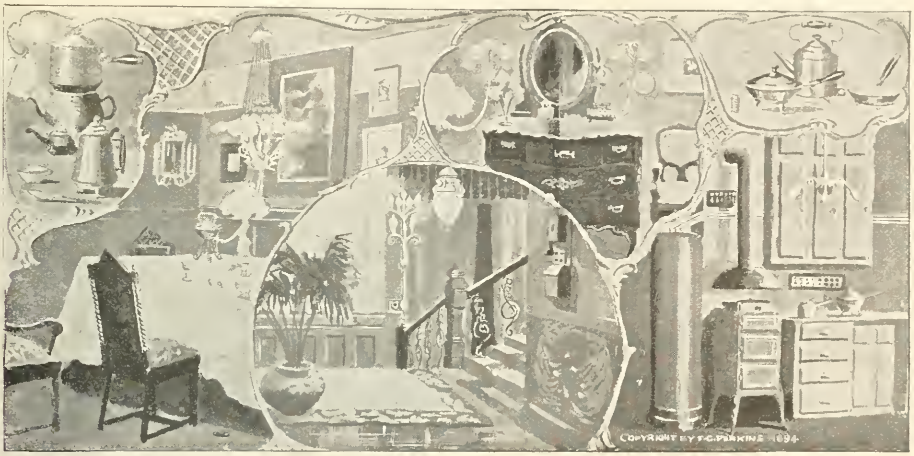
World's Fair. An entirely new design, similar, for example, to that shown in the accompanying illustration could be made. Arrangements could also be made to take visitors behind the scenes and show them how the changes are produced; the means of accomplishing the wonderfully realistic effects would prove to many not less interesting that the effects themselves.

An electrical cascade as near a miniature Niagara as possible should be made, with thousands of gallons of water falling over electric fire, appearing and disappearing in colors of the rainbow and with flashes of lightning. The water should be pumped by electric pumps operated by power transformed at Niagara and a double transformation thus made—the falling water at Niagara transformed into power, then into electrical energy, and after being transmitted over 20 miles of wire, retransformed to power pumping water over the miniature Niagara.

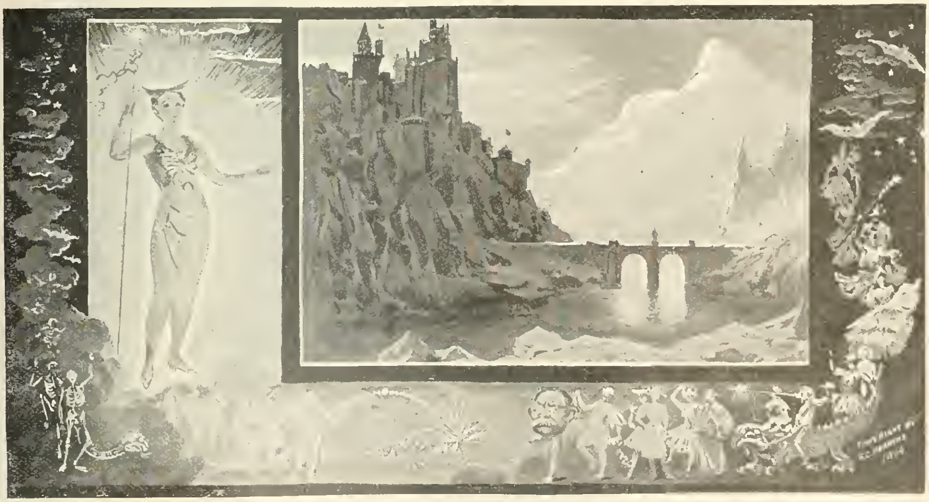
The use of electricity has been steadily increasing in New York and Chicago theatres for several years, and something wonderful in this respect should be secured for Buffalo during the carnival.

The Buffalo electrical night procession can easily be made to surpass anything ever done in that line. Floats can be mounted on trucks drawn with horses or by electromotors, simply using trolley car trucks and motors, the current to be fed from the trolley wires for both the illumination and propulsion of the floats.

Some enterprising furniture and decorating establishment should make an exhibition covering the many uses to which electricity can be applied in the household, including a display of the artistic effects possible in decorating rooms. The accompanying illustration shows some of the possibilities of Buffalo homes of the near future. Ceiling and panel lights are now being brought into use, lamps are automatically turned on by opening doors, curling irons, shaving cups and other articles are electrically heated. Five o'clock tea in parlor or sitting room, at which, by means of a simple button or switch, heat may be supplied and tea made or chafing dishes heated; electric dish washers, electric cigar lighters in the smoking room and even electric boot polishers; electrical pianos that play selections from several hundred pieces; ventilators, dumb waiters, elevators operated by electric motors, as well as coffee grinders, silver ware buffers, and laundry and ironing machines; these are but a few of the appliances that might be shown and which will be within the reach of the household in Buffalo through the utilization of Niagara's power, and whose final realization the electrical carnival should fitly inaugurate.



ELECTRICITY IN THE HOUSEHOLD.



THE ELECTRICAL SCENIC THEATRE.

Wire Losses, Over-Compounding of Dynamos, and Regulation of P. D. in Multiple Arc Circuits.

BY E. P. ROBERTS

PRELIMINARY NOTE.—Since writing that which follows this paragraph, Prof. Crocker's criticism has appeared. That which Prof. Crocker states is certainly correct, although the writer is inclined to think that he puts somewhat too much stress on the omission, in the article of Oct. 13th, to state that the equalizer bar method was successful in practice after having made the statement that it is correct in theory. From the standpoint of the criticism the point is well taken. The article was intended to deal with errors in a practice which is daily followed by engineers in good standing, and the degree to which the error is injurious, and it was not intended to deal with other methods, though, in the light of Prof. Crocker's criticism, the facts which he states could wisely have been incorporated, and the writer advises that such be done by the reader.

It was an unexpected pleasure to the writer to find that his note entitled "Relation between Line Wire Losses and the Over-Compounding of Dynamos," published in the Electrical World, Oct. 13th, was considered worthy of an editorial notice, and also to find it considered by the *Engineering Magazine;* and, in addition, to receive a number of personal inquiries relative to the subject. The "raison d'etre" of this article is that both personal and editorial criticisms and comments have led the writer to believe that the

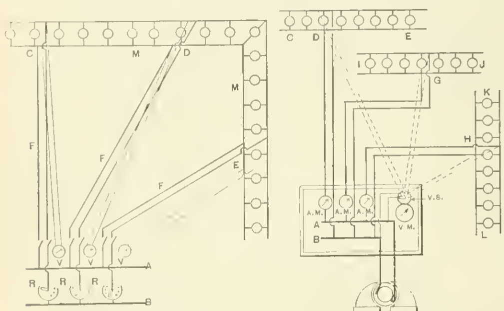


Fig. 1 Fig. 2

DIAGRAM OF CIRCUITS.

following notes may be of assistance to those who have not studied the maintenance of constant P. D. at the translating devices of a Multiple Arc Circuit.

An article by the writer of this paper was printed in The Electrical World of March 3d, showing various systems of wiring for M. A. circuits, and their comparative advantages as far as even distribution is concerned. The usual system for a plant for general distribution is, as shown in Fig. 1 of this article, and for isolated plants, either as in Figures 1 or 2.

First. Let us consider the inherent weakness of the system shown in Fig. 2, taking only one branch circuit, and, for convenience sake, considering that we can obtain a wire to give just the line drop indicated at full load. If it be decided to lose four volts from A to D and return, and one volt between C and D, and also between D and E, and not over 100 volts is to be allowed at when D at full load and 20 amp. flow across at C and at D and E we will have at C and E 99 V. and the R. of D to C and of D to E. .05 and of A. D. B.—$.06\frac{2}{3}$ and the V. A. at A.B. 104 V. If the P. D. at A. B. be constant, the condition of greatest rise of P. D. at the translating devices is when the load is lightest and if .5 amp. only be used and be taken off at D., and then at P. D. at D. rises to 103.97. This is the one extreme case, and how nearly it will be reached, depends upon the *conditions of the case and the care and skill of the designer.* If, then, the P. D. is to remain constant at D, that at B. must have a range of from 100 to 104. It is evidently impossible to have C. D. and E. at the same P. D., and the practice is to have the loss between them small and put the loss in the feeder. If such is done, evidently the P. D. at A. B. must be capable of regulation.

Second. Let us consider the case of several such circuits from a constant source. (See Fig. 2). Evidently if any one branch is fully loaded, another one at half load, and another one at very light load, the P. D. at the source can only be regulated to be that which is correct for some one circuit. *In order to make the average P. D. correct,* probably the circuit half loaded would be chosen, if any choice be made, *and if there exists means for determining the conditions and for the adjustment thereto.*

Third. From the condition of Sec. 2, arose the design of the feeder and main system shown in Fig. 1, consisting of a number of feeders, serving one system of mains, of voltmeters to indicate the P. D. at the junction of feeders and mains, and of resistance to cut into the feeders to maintain either constant P. D. at the junction, or to have the same lowered when the C. in the feeder lessens. Constant, or almost constant P. D. is maintained at the bus bars A. and B. The amount of R. was found to be large and bulky, and the manipulation, in large plants, a source of considerable difficulty.

The next step was to employ a large number of feeders and a supplementary source of P. D. greater than that generally needed. When the P. D. at any feeder end becomes high the feeder is cut out; when low, it is thrown into the high P. D. bus bars.

The next improvement was to increase the P. D. by a "booster" and is the method employed on many alternating as well as direct current circuits.

Fourth. The system described in section 3 necessitates apparatus and attention not usually obtainable for isolated plants, but the general principle remains the same, and an isolated plant has before it a choice of evils as has a larger plant, and, in fact, almost every plant of any character. The isolated plant wiring must either be arranged as a number of circuits of the character indicated in Fig. 2, or on the feeder and main system shown in Fig. 1. If Fig. 2 be chosen, there should be indicators of current A. M. for each circuit, and voltmeter at V. M. connected at A. B. and the voltage cut down either to that necessary for the least loaded circuit or slightly above, or means for determining the voltage of one or more distant points, preferably, one of each circuit, and the voltage adjusted thereto In either case, means must be furnished for regulating the P. D. at the source, and it is very seldom that it is wise to have such P. D. rise in proportion to the current output. Generally, something less is preferable, and any automatic means should so deliver it, leaving hand regulation for the finer adjustment.

Fifth. If only one dynamo is employed, then its P. D. should rise somewhat, but not exactly, in proportion to the current output and the line loss. If a number be employed, it is best not to have them over-compounded at all, or, at most, to only a very small amount, depending upon the ratio of size to total load. (This was explained in the article of Oct. 13.) Also, as the E. M. F. varies according to the temperature of the dynamo, the hand control should have sufficient additional range to compensate for same.

Sixth. Plants having only small wire losses, say 4 per cent. or less, can be operated with a close approximation to accuracy by having the circuits carefully laid out and having quite a number, though not necessarily a "multiplicity," and when it becomes necessary to throw in additional dynamos dividing the circuits, giving some to each dynamo, and, as far as practicable, putting all the light loads on one and keeping its voltage down. When there are not many dynamos there is no trouble or complication in doing this. If, however, it be considered preferable to operate the dynamos in multiple arc, have hand control and means to determine the P. D. at the lamps or the C. in each circuit and the P. D. at the dynamo.

Whether the system of Fig. 1 or Fig. 2 is best to use for an isolated plant, depends upon the conditions of the case. The greatest load, the variation of load as a whole and in the various sub-circuits, must be considered. and also as to whether the control of each circuit from the main switchboard is desirable. Whatever the wiring system, the degree of over-compounding of the dynamos and the amount of wire losses have no fixed relation and hand control is always advisable. If there be only one dynamo and the load increases and decreases in all parts of the circuit in the same ratio, then, and *then only,* should the dynamo be over-compounded in the ratio of the line loss to total load. Even in the last case a hand regulation is advisable to compensate for temperature of the dynamo.

If more than one dynamo be used and the circuit be divided so that each dynamo operates independently, the conditions are similar to the preceding paragraph. If the dynamos be used either individually or collectively, and the series winding be not connected by an "equalizer," the over-compounding of each should be the same as that of the smallest dynamo used, which should be such that when it is operated alone and at full load, the P. D. at the lamp is that desired. If the total line loss be ten per cent. and the

smallest dynamo have a capacity of one-quarter the total load, it should over-compound two and one-half per cent.

Therefore, dynamos, when used as stated, should be shunt wound, or only slightly over-compounded, or connected by an equalizing bar and should always have a hand rheostat.

All other features being equally good, the man who can and does pay attention to the above considerations, produces a better plant than the man who slights them. Possibly the clients will never know the difference, but the designer will, provided he be competent, and that should count for something. If the plant be for incandescent electric lights, special care, instead of general plans, along some broad path intended to be an average and really not suitable to anything, will save the client from one to five per cent. yearly on his investment. The investor is not likely to consider the advisability of purchasing such advice when professional men relegate wiring plants to the "wire man," or the average installing "expert," admirable artisans as such men may be. Even the recently graduated collegian, with his magnificent training for the future, and his lack of knowledge of the conditions of practice, is not the man best fitted to design wiring plans, or to consider the mutual relation of the various elements of the electric light plant.

Transformer Testing.

BY EUSTACE OXLEY.

A transformer of the present day is an exceedingly efficient piece of apparatus, even when operated at small loads, but the combination of a large number of small transformers, with their primaries connected to the mains twenty-four hours out of twenty-four, and with their secondaries open eighteen hours or more out of twenty-four, is a source of loss and inefficiency which has for a long time provided direct current, low pressure advocates with their main argument against the employment of the alternate current system.

If consumers could be provided with a suitable switch for opening the primary circuit of their transformers when their lights were not in use, and at the same time could be relied upon to do so, this loss of power might be avoided; otherwhise, it would seem that the so-called "banking" of transformers, in connection with a low pressure distributing network, was the only remedy.

In a system where every consumer is provided with a separate transformer, this loss at no load is of great importance in determining the all day efficiency, and it is therefore advisable to test all transformers before they are sent out from the central station to be connected with the mains. Tests should be made of insulation, magnetizing current, core loss, efficiency and drop.

Insulation.—The insulation between the coils, and between the coils and the shell, should be able to withstand the application of a

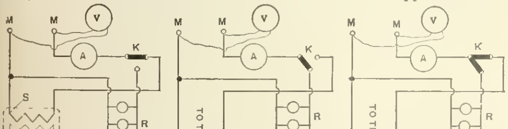


DIAGRAM OF THREE AMMETER METHOD.

P. D. equal to twice the primary voltage at which the transformer is intended to work; thus, a transformer intended for use on a 1,000-volt circuit should be tested for insulation between these parts, with a pressure of 2,000 volts.

Magnetizing Current.—Measurement should be made of the magnetizing current, *i. e.*, the current which passes through the primary coil, when the secondary current is open.

Measurement of Core or No-Load Loss.—The "no load" loss is the power absorbed by the primary, when the secondary circuit is open. There are several well-known methods of measuring the power taken up in a transformer, but they are not all, however, adapted for use in the workshop. Those commonly employed are the "Three Voltmeter" method of Prof. Aryton and Dr. Sumpner; the "Three Ammeter" method (a modification of the first by Prof. Fleming), and various "Wattmeter" methods. The first two are very similar, the difference being that in one case you measure volts, and in the other current; in both a single instrument may be used to take the three readings. Eminent authorities have advocated the use of the wattmeter for measuring power in alternate current circuits; however, workshops are seldom provided with a suitable wattmeter for the purpose. As the three ammeter test can be made with an ordinary Siemens dynamometer and a voltmeter capable of measuring the volts on the low pressure side of the transformers, it is perhaps most generally employed. Although this method has been frequently described, it is possible there are some who are not yet acquainted with it, so perhaps a short description would not be out of place.

To measure the "no load" loss in a transformer, arrange things as shown in Fig. 1, where *MM* are the secondaries of another transformer providing the proper voltage, *A* the dynamometer, *V* the voltmeter, *T* the transformer under test, *P* the primary, and *S* the secondary coil; *R* is a non-inductive resistance, such as incandescent lamps, and *K* a three-point switch, conveniently made with mercury cups and copper connecting pieces. The primary circuit is left open during the test. The voltage must be kept steady and at the proper value. Then if C is the current which flows through the transformers alone (when K is as in Fig. 1) and C_1 is the current which flows through the inductionless resistance, R, alone (when K is as in Fig. 2), and C_2 is the current which flows when the transformer and inductionless resistance are placed in parallel with one another (when K is as in Fig. 3), and V is the voltage, read by the voltmeter, then the power in watts absorbed by the transformer will be,

$$W = \frac{V}{2\,C_1}\left\{ C_2^2 - C^2 - C_1^2 \right\}$$

the greatest accuracy being when C is made equal to C_1.

Efficiency Test.—When it is required to test the efficiency of a transformer at different loads, taking measurements on the low pressure side, two similar transformers are needed. The primary coils of the two transformers are connected together, and measurements taken of the power taken up by the secondary of the first, and that given out by the secondary of the second. The loss is then divided between the two transformers, and their efficiency determined. Dr. Sumpner has given a method for measuring the iron and copper losses in a transformer by means of a single wattmeter. It consists in measuring the watts taken up by the secondary when the primary circuit is open; this gives the "no load," or "core" loss; then the secondary is short-circuited and the power measured absorbed by the primary when the full load current is passing in the secondary. This gives the "copper" losses, and adding these two together gives the total losses in the transformer.

A method * of finding the efficiency of good, closed magnetic circuit transformers at all loads is to calculate the $C^2 R$ losses at different secondary loads, and adding to this the "core" loss, thus getting the total losses at different loads, from which an efficiency curve can be plotted. The "core loss," which is constant at all loads, may be got by multiplying the apparent power absorbed at no load by *OS*. This last figure is the value of the power-factor at no load, as determined by Prof. Fleming, after an exhaustive series of tests on transformers of different makers.

Regulation.—The drop in the volts of the secondary circuit with increase of load should be measured. The "total drop" being the difference between the secondary volts at no load and full load. This drop of voltage is due to resistance in the primary and secondary coils, and to magnetic leakage. It is of course desirable that transformers for use on lighting circuits should have as small a drop as possible.

Mathematics and Mathematics.†

A glance through the transactions of learned societies will show how the subject of electromagnetic theory may be treated by men who are only a little better than mathematicians. We say better, because even a little knowledge of nature must improve the pure mathematician, and only the very smallest knowledge of nature suffices to differentiate the pure mathematician at Cambridge from the mathematical physicist. Let us look up an elaborate paper on this subject by a mathematical physicist. We are practically engaged in electrical work, but we think it good occasionally to think of the soul instead of the mere body, and we know that somehow the mathematicians can tell us more about the soul of our subject than we ourselves know. Well, how much of such a paper can any of us understand? There are three or four people in the whole world at the present time (certainly not more than five who have practical notions of things, and who are also able to thoroughly understand such a paper. If you question the author of the paper, who has written perfectly accurately of current and

* See paper by Professor Fleming, Inst. Elec. Engs., No. 101, Vol. XXI.

†From the London *Electrician*, slightly condensed.

potential, you will find that he knows absolutely nothing of amperes and volts, that he has not the slightest interest in wires or batteries or dynamo machines. And yet those pages of his paper which bristle with mathematical expressions may contain a story which to us is of very great interest, only the author cannot talk our language, and we do not know his. We have almost no common sympathies.

With Mr. Heaviside we are in the company of a very clever, good natured elder brother, who has exactly the same likings as ourselves for all sorts of experimental work, and who tries to explain deep things to us in language that we can understand. Sometimes he cannot get down to our level; but he always tries to do so, and we ought to try harder to second his efforts than we have hitherto done. It is absolutely certain, it has been proved as clearly as almost any physical fact is ever proved, that electromagnetic energy travels through the space external to a wire, and not in the wire itself, as we used to believe. Is there any electrician who does not know this? Is there one of us, however scornful of mathematicians, who would not give a deal to be able to see clearly, say as clearly as Mr. Heaviside sees it, how the thing occurs? We are willing to give a good deal, but we are not willing to give all that we possess, and that is the price demanded by the mathematician. He says, you must give up all chances of obtaining practical knowledge of electrical things, you must by years of study get familiar with elaborate mathematical expressions, and at the end the sort of notion which you will have obtained is the notion that I have, and not the notion that you think you may have.

What Mr. Heaviside says to us is a very different thing. He will probably be rather angry at our way of putting the matter; but this is how we read him. Look over that elaborate mathematical paper again; you will notice in page after page of it the same mathematical expressions endlessly repeated, for the benefit solely of the printer. They are really very few, and every one has a definite and very interesting meaning. Suppose we do not print them as they stand—let us use Mnemonics. The mathematicians do not need mnemonics; even those of them who have the very worst memories have become so accustomed to these expressions that they glance over a page of new work in half a minute and understand it all. Here is a frightful expression which we see repeated in every other page. Well, then, let us (as Maxwell did) call it curl. But once for all let us try to understand what it means, and we all at once discover (like M. Jourdain, who made the same sort of discovery) that the idea underlying curl has been familiar to us for years, and that if we had not the idea we should know nothing whatsoever about our ordinary practical work. The Greek mathematicians thought it well to make their pupils spend years in leading up to the proof of the 47th proposition of the first book of Euclid. Would there be great harm in telling pupils now-a-days that this proposition is really an axiom, and so save all those years of study? We study for two reasons. One is this, that the mere study is a mental gymnastics; the other to gain knowledge. The best kind of study gives both knowledge and mental power. We electricians have no lack of mental power; if ever practical men had mental gymnastics in greater degree than we, we should like to hear of them. But even our best friends will say that our knowledge of what goes on in the electromagnetic field is rather limited. As, then, our profession may be relied upon to give us an intellectual training, as we have no examinations to pass, as our mathematical tools are for use, not show, it is very important that those tools should be of the very best and latest labor-saving make. Our teachers act on the principle that each of us must only use such tools as each of us himself can make. Prof. Tait is of opinion that no man ought to be allowed to use a table of logarithms until after he can himself calculate logarithms. We presume that he would allow no boy to use a watch until he was able to make one. These teachers of ours gave us all the Euclid we could stand. How unhappy they must be in not being able to teach us multiplication by the Trireme method and how abominable it must seem to some of them that the decimal system was ever invented. There are still plenty of useless jobs to be done to keep boys dull. Think of making a man spend one year at geometrical conics and the next year at analytical conics, and dosing him with more and more perfect proofs of Taylor's Theorem. These are the memories which cause an electrician to regret his lost youth. Do electricians ever need to solve a triangle, unless it is a simple right-angled one? Are there not curves more interesting to us than conic sections? And seriously, however beautiful Taylor's Theorem may be, does the electrician ever need it? When shall we see a good list made out of the mental tools most needed by the electrician?

The Successful Application of Electricity to the Operation of Mines.

Mr. W. F. C. Hasson recently read a paper before an engineering society of the Pacific Slope with the above title, which forms an interesting contribution to a subject in regard to whose more practical and commercial details he has had unusual opportunities to become informed.

Referring to a statement made at the Electrical Congress held during the World's Fair in Chicago, by one of the most prominent engineers of one of the large manufacturing companies, to the effect that he regarded it the business of consulting engineers to assure the public of the practicability of electrical machinery for the transmission of power, long distances, Mr. Hasson said that t e independent engineers, recognizing that the perfecting of electric machinery for long distance transmission would only keep pace with the demand for such machinery, have been compelled to rely more or less upon their own intelligence and reputation for honesty in advocating the investment of money in such enterprises. Heretofore, the data furnished by the electrical companies has been very meagre, and it has been impossible for the engineer to satisfactorily give even preliminary estimates concerning the cost of machinery. The past year has seen great advance in the standardizing of machines and the publication of sufficient information to enable the intelligent investigation of the feasibility of proposed transmissions.

So much, he said, has been written and said about the success and economy of the utilization of water power and the great variety of purposes it may serve when transformed into electricity, that numerous companies have been formed to transmit unlimited power unlimited distances. Incipient electricians, armed with a few figures, great faith and little understanding, see fame and fortune ahead of them, and talk bravely of the possibilities of cheap power for railways, town lighting, manufacturing and mining plants, and irrigation machinery. So powerful is the effect of a small conception of the possibilities of electricity that it apparently induces in the hopeful mind a great and firm belief in itself. Men who have a faint conception of the elementary principles of electricity unhesitatingly state their willingness to undertake the transmission of 20,000 horse power 100 miles, under ground or water, as may be desired. The variety of statements freely furnished investigators leaves them in an uncertain frame of mind as to whether there is any truth whatsoever in claims made for the various types of machinery.

After describing several systems for the transmission of power, Mr. Hasson said there are several companies in the United States prepared to manufacture the necessary machinery to meet any of the circumstances enumerated, and, further, prepared to guarantee its successful operation. It must be borne in mind, however, that guarantee, however responsible the contractor may be, really means but little. Although the payment for machinery may be made dependent upon the fulfillment of the guarantee, this by no means compensates the purchaser for the money lost by delay, and the consequent trouble and worry. The only real safeguard is the selection of such machinery as is known to be successful, and the taking of every precaution that its selection and installation is placed in the hands of capable people, whose only interest is in the successful operation of the machinery—and not in the profits accruing from its sale.

The vital question, in the opinion of Mr. Hasson, is the comparative cost of operation of the mine by electrical machinery, and by steam or water power. In that connection there is presented the absolute cost of electrical machinery and its operation, and the cost of the engine and boiler plant and its operation, to produce equal results at the Standard Consolidated mine at Bodie. At the time the machinery was contracted for this mine there was but little absolute assurance of its successful operation. That the electrical difficulties incident to the locality were little understood by the engineers of the contracting electrical company, is evidenced by the fact that it required the greater portion of a year to get the machinery in successful operation. The figures in this case are as follows:

Expense for electrical machines, water wheels, wire and pole line material, freight and all construction and installation for a plant to develop 150 horse power at the mill	$26,000
Total expenses, including pipe line and power house and other buildings necessary.	$37,000
Estimated cost of engines, boilers, freight, construction, buildings, etc., for a high grade steam plant to develop equal power.	$13,000
The expense for fuel for production of power for the year ending February, 1893, was.	$22,700

This leaves a balance in favor of steam machinery of $24,000 on first cost, while the fuel expense is completely wiped out by the use of electric machinery operated by water power.

Allowing $700 per annum for heating purposes, the annual saving in fuel becomes	$22,000
Assuming a period of operation extending over 10 years, the amount expended in fuel at 6 per cent. compound interest becomes	$307,000
Against this must be charged the original expense and compounded interest on the extra cost of electric plant over that of steam plant, amounting to	$43,000
The balance in favor of the electric plant is	$264,000
The wisdom of the adoption of electric power in this instance is emphasized by the fact that the average annual dividends for the two years ending February, 1894, was	$28,500

The conclusion is drawn that, all circumstances remaining the same, the saving in fuel will practically double the dividends. The cost of attendance for the electric plant will be slightly in excess of that for a steam plant, but the cost for maintenance and charge for deterioratiom should be less. The Standard Consolidated Mining Company, Mr. Hasson adds, is now making arrangements to install an electric plant for the operation of hoists and mine machinery. This plant will effect an additional annual saving of $11,000, heretofore expended for fuel.

Mr. Hasson also gave an estimate concerning the installation and operation of machinery for a 40-stamp gold quartz mine and mill under the following conditions:

Distance to available water power	20 miles
Capacity of generating plant	300 horse power
Type of machinery	Multiphase, alternating current
Transmission voltage	10,000 volts
Maximum loss in transmission	10 per cent

Demands for power:

90 horse power for stamps, crushers and concentrators.
75 horse power for hoists.
50 horse power for pumps.
15 horse power for electric lights.

Annual operation	350 days of 24 hours each
Estimated period of operation	10 years
The cost of necessary electric and hydraulic machinery and wire for transmission, all f. o. b. San Francisco, together with expense for material and construction of pole line and stringing wires, should not exceed	$36,000
The cost of engines and boilers to produce equal results, with the exception of the electric lights, all f. o. b. San Francisco, would not be less than	$10,000
Assuming cost of transportation and installation of the two classes of machinery to be practically the same, the difference in the first cost in favor of steam machinery becomes	$26,000
This, regarded as a 10 years' investment at 6 per cent. compound interest, represents	$46,500
The annual difference in expense for fuel, operation, maintenance, insurance, taxes, etc., in favor of the electric and hydraulic plant, will not be less than	$40,000
Regarded as an annual investment at 6 per cent. compound interest, this in 10 years amounts to	$558,500
The total difference in favor of the electric plant thus becomes	$512,000

From this, of course, must be deducted the accumulated value of the investment necessary for the development of the water power. These estimates, he said, are not to be taken literally, but they truly represent the great margin there is in favor of the electrical transmission of power, when the matter is considered on a business basis.

These results being true (and in one case they have been actually established), Mr. Hasson stated that the question naturally arises as to why there should be any hesitation in the investment of money in power transmission enterprises, and why so little advantage has been taken of the possibilities that exist in that direction on the Pacific Coast. Among the answers that may be given he enumerates the following:

1. The electrical manufacturing companies exploited the field and claimed to be prepared to meet the demands for mining machinery before such machinery had even been designed. Finding that a demand existed, machines were designed to meet ideal conditions. It is by no means surprising that when installed as ignorantly as they had been designed, many unforeseen obstacles prevented the successful operation of these machines. However, it was from a study of these difficulties, and the devising of methods for overcoming them, that perfected systems have finally been obtained. Further, being themselves ignorant of the probable cost of machines, the preliminary estimates were in many cases made so high as to prohibit their use. This is evidenced by the fact that at frequent intervals during the past two years estimates have been made for the cost of machinery to transmit 1,000 horse power in Nevada County, and the present estimate is one-fourth of the original one.

2. There is a definite lack of confidence on the part of the mine owners as to the successful operation of electrical machinery, owing in part to the failures that have occurred due to the causes stated, and in part to the fact that electricity is regarded as a very mysterious element. The manufacturing of electrical machinery is no longer any more of a mystery than that of building engines and boilers. One great error on the part of those investigating the feasibility of employing electric machinery is in relying on the manufacturing companies to freely do their preliminary engineering work. Although the electrical manufacturing companies have been liberal in pioneer engineering work, their province is to make and sell machinery. If they are also called upon to do free engineering work in all parts of the world, and still make a profit on their machines, the prices of necessity must be made high accordingly. It must be self-evident that in relying on the manufacturing company for engineering advice, the purchaser eliminates the possibility of that competition which he should desire. Further, an agent whose salary is dependent on commissions on sales should hardly be placed in the position of giving disinterested advice as to the practicability of any proposed enterprise.

3. In the conducting of any enterprise dependent on cheap power for its success, it would appear essential to retain control of the production of that power. In the development of new industries in California, the tendency is always to look to foreign capital. If the venture fails, the foreign capitalist has a grievance that he ventilates and prevents investments in legitimate enterprises. If the venture succeeds, the chances are in favor of its becoming a monopoly, and the original enterprise is at its mercy. In cases where there are groups of mines dependent on cheap power that requires capital only for its development, it is certainly advisable for the mine owners to strain every resource in order to retain control of the power company.

Mr. Hasson in conclusion states that the following facts are assured:

Electric machinery, guaranteed to efficiently transmit power for multifarious purposes, can be purchased at moderate prices.

Carefully selected, properly installed, and controlled by companies governed by a financial policy that reaches beyond the moment, it can be made to play an important part in the development of the industries of the Pacific Coast. It may be accepted as an axiom that no electrical transmission of power is absolutely impossible, considered as an engineering problem, although it may be thoroughly impracticable from a commercial standpoint.

With the revival of hydraulic mining and the economic methods now offered for the operation of mines requiring extensive power, it would appear that the mining industries of the Pacific Coast, instead of being on the wane, are on the eve of a period of assured success; and the men who have devoted their time, money and energy to the maintenance of those industries during the time of depression are to be congratulated on the bright future in view.

Current and Lines of Force.

BY B. S. LAMPHER.

The following rule gives the relation of the electric current to the lines of magnetic force produced by it:

If you look at the positive (or north) end of an electromagnet, the direction of the current setting up the magnetism is that of positive rotation. Similarly, if you imagine a section made in a conductor carrying a current and look at the positive end of this conductor (*i. e.* the end from which the current is flowing) the direction of lines of force set up about the conductor is the direction of positive rotation. Conversely if you look at the negative (south) end of a solenoid, the direction of the current is that of negative rotation, and if you look at the negative end of a conductor (*i. e.* imagine a section without really breaking the circuit) the direction of the lines of force about it will be that of negative rotation.

Every student of electrical engineering knows that positive rotation, mathematically speaking, is opposite to the hands of a watch, and he also knows what is meant by the positive end of a magnet and the positive terminal of a conductor. Accordingly, if he remembers the rule at all he cannot make a mistake, like substituting "right hand" for "left hand" or "clockwise" for "anticlockwise." It is a positive rule; positive end means positive rotation and positive rotation gives a positive end.

Moving Sidewalks.

A sub-commission of the universal exhibition to be held in Paris in 1900 met recently to consider various proposals brought forward in connection with the exhibition. One of the schemes suggested is by M. Blot, of Paris, for a moving sidewalk, similar to that at the Chicago Exhibition, to be worked by electric power in the grounds. Another project, this by MM. Casalonga and Faure, of Paris, is for the construction of a metropolitan railway operated on the same principle.

Notes on the Management of Railway Power Stations—IX.

BY GEORGE T. HANCHETT.

The Car Equipment (Electrical).

By a careful management of the controller the life of the whole equipment is so much prolonged that a knowledge of it is important. In starting the car, be sure that the switch overhead is closed, the reversing lever in its proper position, the trolley on, and the fuses in place; then move the controller forward a notch. If the car does not start, throw off the controller and examine the switches and fuses. If these are intact examine the ground contact at the wheels. A poor connection is liable to exist at contacts where the pressure is great and the contact apparently clean. For instance the writer has seen the output of a thirty-arc dynamo reduced a hundred volts by greasy brushes and commutator. The sand papering of the commutator and trimming of the brushes increased the output to its proper value.

The car wheels are very liable to make a connection of such a resistance with the track as to cut the current down to such an amount, as to be too small to give the necessary starting torque. By driving the blade of a switch under the wheel from *behind* the difficulty may be removed and the car started. It sometimes happens that one of the motors is cut out. If this is the case the car may not start till the controller handle is moved one half way round on its course or, in other words, to the position where the motors are in parallel. Having started the car, allow the speed to become fixed on one notch before moving to the next. In stopping the car swing the controller handle around to the last notch with moderate speed and throw against the stop with a snap. The best controllers are liable to more or less trouble from the arcs formed at the contacts, and this will tend to obviate it. Do not apply the brake till the controller is completely off.

The rapid reversal of a car is sometimes necessary. In order to give an idea of what is going on at the motor when this is done the following calculation is presented. Consider the case of a twenty-five horse power motor which, working at full load, consumes say 40 amperes. Assume that the combined resistance of the fields and armature is 0.4 ohms. The drop through the armature and fields is then $0.4 \times 40 = 16$ volts. This leaves the back E. M. F., if the trolley voltage is at 500, $500 - 16 = 484$ volts. If the motor be suddenly reversed, the impressed voltage and the back E. M. F. work in conjunction to produce current in the armature. If there were no self induction and the current had time to attain its full value, there would be established, if 500 volts is maintained at the trolley,

$$\frac{500 + 484}{.4} = 2,460 \text{ amperes}$$

in the motor. Practically, due to the causes before mentioned, the current will be much less, but in any event it will be of sufficient volume to blow the fuse and will thus deprive the motorman of his most powerful means to prevent an accident at a time when it is most needed.

It is, therefore, absolutely necessary, no matter how urgent may be the necessity of instantly stopping, to be slow and deliberate in reversing the motor. Shut off all current completely and then throw the reversing lever. It will now be found that the first notch of the controller will quickly stop the wheels, the second will not only stop the wheels with a sudden jerk but will skid them the other way and any more notches than this is almost sure to blow the fuse. If the car is moving slowly, more than two notches may be used, but at high speed two will be found sufficient. This is the exact reverse of what the layman would expect, but it is nevertheless a fact. Of course, in urgent cases the quicker the current is shut off and the reversing lever thrown the better, but in turning the current on again it becomes necessary to be deliberate. This combination of first hurried and then deliberate action, is something that few men can accomplish, and so it is best for the average man to strive to attain a cool, precise, deliberate control, for excitement in time of accident will tend to make him rapid, often too much so. Copper wire is used almost entirely for fuses at present. If each motor man were supplied with a number of marked fuses and a record of them kept, a result would be obtained that would give data as to the relative excellence of the motormen and the difficulty of the various routes. The successful manager of a line of steamers has the records of the most minute occurances of every voyage. It is much easier to obtain such data regarding a street railway system, and perhaps that is the reason why it is not generally done.

If an accident happens to one of the motors in the nature of a grounded wire, a burned-out field coil or the like, stop the car and open the trap doors. By turning on the controller a notch the defective motor will at once reveal itself by smoking or flaming at the injured part. Shut off the current at once, and having thus determind which is the injured motor, cut it out, and proceed with the remaining motor.

Remember that pulling down the trolley is a sure cure for any electrical difficulty. Always do this when replacing a fuse and thus avoid a shock. If the trolley comes off while the car is in motion, pull it down at once. Neglect of this may result in pulling down a line of trolley wire or even wrenching the whole roof off the car. For the same reason never run the car backward unless some one watches the trolley, holding the cord in his hand. Whenever the trolley comes off the current should be shut off. Never stop a car on a curve unless absolutely necessary. The large amount of power needed in starting from such a position is liable to seriously damage the motors and gearing. Never leave the car in such a way that it can be operated by any but the proper parties. Remove the controller handles, and throw the overhead switch. In a thunder storm there is very little danger except to the motors. If one of these is damaged, cut it out. If both are affected, pull down the trolley and wait for the next car to push the disabled one to the car barn.

If the two motors face each other between the wheels, as is usual, the strain on the two motor supports is very different. Suppose that we have a 25-hp motor driving the car at ten miles an hour. Assume a thirty-inch wheel.

At this speed it will make

$$\frac{10 \times 5,280 \times 12}{60 \times 30 \times 3.1416} = 112$$

revolutions per minute practically. If the motor support be $22\frac{1}{2}$ inches from the axle, the pressure upon it due to the power exerted will be

$$\frac{25 \times 33,000 \times 12}{2 \times 22.5 \times 3.1416 \times 112} = 625 \text{ pounds.}$$

On the forward support this force is added to the weight of the motor, while on the rear support it is taken from the pressure of the motor thereon. Therefore, when a motor drops into the street due to the failure of its support, it will be easier on the temporary support to cut the motor out, if it be a forward one, and to allow it to operate, if it be a rear one. The fact that this extra weight due to the power exerted is often overlooked in the design of motor supports, is responsible for many failures.

The current should be shut off when crossing a section insulator. This will save both insulator and motors. Be sure to remove the trolley when inspecting or adjusting the motors. Beside being a protection from shocks it is also a safeguard against short circuits from tools, or knives, keys etc., falling out of the pockets into the motor. A switch or the controller may be grounded, but if the trolley is down the current is positively off. If the trolley flashes on placing it on the wire when the switches are open and the lamps and heaters are off, something is wrong. The conductor should frequently test the car in this way and report it at the station.

The trolley wheel is one of the most neglected parts of the whole equipment. It must turn freely, for if it sticks and skids along the wire, flat surfaces will be produced which, when the wheel is set turning again will cause it to chatter and spark incessantly, and effect speedy destruction. Oil is a good insulator and consequently a bad thing for a trolley wheel bearing. Some modern wheels have graphite bearings, but on the old fashioned trolley wheels a mixture of powdered graphite and oil will be found much better than oil alone.

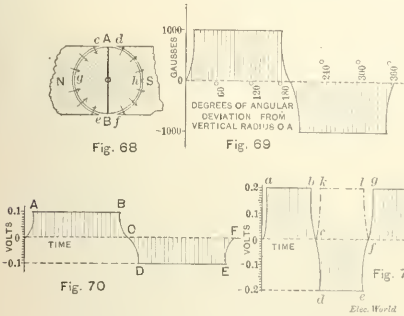
The series parallel controller has been one of the most marked improvements of modern street railway equipment. By its means the car can be operated at half speed at nearly the same economy as at full speed. In crowded cities where the traffic is very heavy and the cars on the suburban lines are few in number, it is safe to say that this controller saves twenty per cent. of the coal bill. In such cases it is, therefore, more economical to discard all other forms. This has been largely done; but in this, as in every other economy, there are a certain class that are blinded to future economy by first cost.

In the management of an electric railway equipment, from boiler down to car, theoretical formulæ and knowledge of principles are of undoubted value, but an abundance of practical knowledge and strong common sense cannot take a second place. The two combined are invincible. A practical college professor once said "The trouble with you technical graduates is that you get a thing ten times too large or ten times too small. The theorist will make this error, and the practical man, while he knows that this cannot be right, cannot calculate what is right, but if either had the others knowledge the mistake would at once be corrected.

Electrodynamic Machinery—XVIII.

BY E. J. HOUSTON AND A. E. KENNELLY.

91. Since, as we have seen, the E. M. F. induced in an armature may be regarded, either as the result of cutting through the flux at the surface, or of altering the amount of flux enclosed by the loops of conductor; and, since in toothed-core armatures, the E. M. F. cannot be regarded as due to the cutting of the flux, it is evident that the more fundamental rule for determining the value of the E.



FIGS. 68, 69, 70 AND 71.

M. F. generated in the armature is that based on the rate of enclosing flux.

92. Fig. 68, shows a single loop of wire wound upon a drum armature, which has by its rotation in the flux, an E. M. F. induced in it of the same type as is graphically represented in the curve of Fig. 69. Supposing that the speed of revolution is such as to produce an E. M. F. of say one volt, in this conducting loop, during its passage beneath the pole faces., then if two turns of wire be wound on the armature at right angles, as shown at *AB*, and *CD*, Fig.75, they will each generate E. M. F. of the same value, in their proper order, as they pass through the flux, and if the E. M. F. from *AB*, is represented by the curve of *a b c d e f g* of Fig. 74 *A*, and the E. M. F. in the loop *CD*, be represented simultaneously by the curve of *h i j k l m n o* of Fig. 74 *B*, then by properly adding and co-directing the E. M. F's. so produced, by the aid of a suitable commutator, we obtain an E. M. F. of two volts, as shown in Fig. 75 *C*, by the curve $p\ q\ r\ s\ t\ u\ v\ w\ x\ y\ z\ z^1\ z^2$. Moreover, while the E. M. F. produced from one wire alone fluctuates between 0 and 1 volt, four times per revolution, the E. M. F. produced by

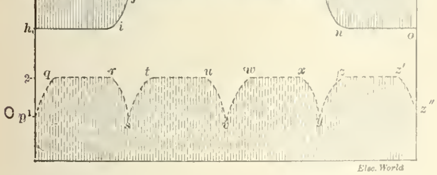


FIG. 74.—DIAGRAMS OF E. M. F.

the combination fluctuates between one and two volts eight times per revolution.

93. If now, instead of two loops being wound on the armature, there are six loops, as shown in Fig. 76, the E. M. F. generated in these, added and co-directed by the aid of a suitable commutator, will be represented by the curve in the same figure, and while the E. M. F. generated in any one of the conducting loops fluctuates between 0 and 1 volt four times per revolution, the total E. M. F. produced under these conditions would vary between 5 and 5.5 volts, 24 times per revolution. In the same manner, if instead of 6 conducting loops being placed on the armature, there are 12 such loops, as shown in Fig. 77, the total E. M. F., if added and co-directed by a suitable commutator as before, would vary between 10.6 and 10.8 volts, 48 times per revolution as shown by the curve.

94. An inspection of the preceding curves of E. M. F. will show that, while the total E. M. F. capable of being produced from a combination of conducting loops, is less than the sum of the maximum E. M. F.'s in each separately, yet their combined E. M. F. is much more nearly uniform than their separate E. M. F's, and tends to become uniform as the number of loops is increased, the curve of the total E. M. F. tending to become more and more nearly a horizontally straight line.

95. In studying the arrangement of the wires on the surface of the armature in a generator, with the view of determining the E. M. F. generated by the revolution of the armature, it is necessary

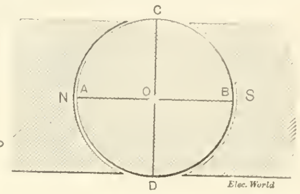
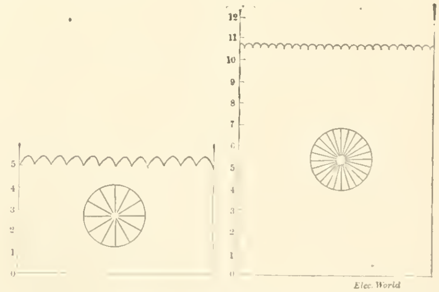


FIG. 75—DRUM ARMATURE WOUND WITH TWO TURNS OF WIRE AT RIGHT ANGLES TO EACH OTHER.

to observe that the E. M. F. developed does not depend directly upon the length of the armature wire which cuts magnetic flux, but does depend dircetly upon the amount of flux enclosed by the conducting loops during their revolution. It is a common error to regard all the wires on the free surface of an armature which does not pass through the magnetic flux as idle wire, and, consequently, detrimental to the efficient operation of the machine. This error arises from regarding the E. M. F. as produced alone by the cutting of flux, whereas in such a case, as for example, a pole armature (Fig. 17), none of the wire cuts the magnetic flux, and consequently would, by the preceding definition, be regarded as idle wire. In reality, the generation of the E. M. F. is dependent on the embracing of flux by the loops, and since the so-called idle wire is necessary to form a part of the loop, it cannot properly be regarded as idle. It is, of course, to be remarked that in the event of the conducting loop having a fairly considerable part of its length formed of the so-called "idle" wire, that in order to permit the loops to embrace a considerable amount of flux during their revolution, requires a rate of cutting flux by those parts that do cut, to be correspondingly increased, thus requiring a greater density of magnetic flux.

That this consideration is correct may be seen from an inspection of Figs. 78 and 79.



FIGS. 76 AND 77.—DRUM ARMATURES OF SIX AND TWELVE EQUIDISTANT TURNS, WITH CORRESPONDING CURVES OF E. M. F.

96. Fig. 78 represents a machine in which the armature is nearly enclosed by polar surfaces, so that, even allowing for the free wire on the sides of the armature, 60 per cent. of the length of the wire is always in the magnetic flux, and 40 per cent. is "idle." Fig. 79, shows a type of armature in which only about 25 per cent. of the length of the wire is at any time in the magnetic flux, so that about 75 per cent. is "idle." Yet in equally advantageous circumstances as regards the cross section of the iron core, speed of revolution, and the number of turns of wire, the E. M. F. from the machine shown in Fig. 79, is fully equal if not greater than that developed in the armature of Fig. 78. If, for example, the polar

surface in Fig 78, were reduced by cutting it away along the lines *ab*, *cf*, and *dc* thus removing the polar edges, and shortening the polar arc by about 50 per cent., the E. M. F. developed by the generator would not be reduced if the same total quantity of flux

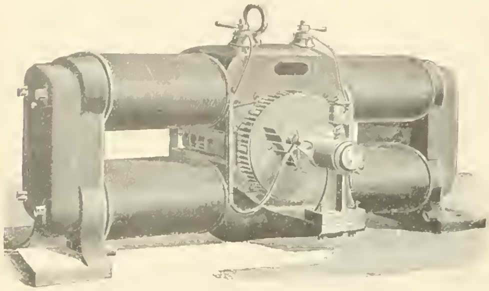


FIG. 78.—TYPE OF ARMATURE HAVING COMPARATIVELY LITTLE "IDLE" WIRE.

were forced through the armature as before. The change affected would be that the reluctance of the air-gap between poles and armature on each side would be increased, since the cross-sectional area of the air-gap would be diminished, and a greater M. M. F. would, therefore, be needed on the field magnets in order to produce the same flux through the circuit as before, but if this flux were reproduced, the amount enclosed with each turn of the armature by its revolution would be the same, and the total E. M. F. induced in

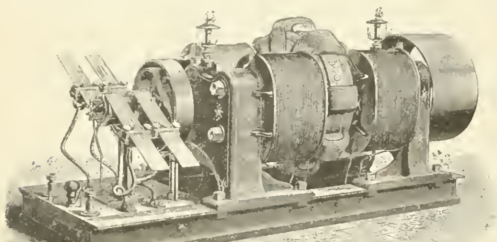


FIG. 79.—TYPE OF ARMATURE HAVING COMPARATIVELY MUCH "IDLE" WIRE.

the armature would be the same; or, regarding the question from a different standpoint, the intensity of flux in the air-gap would be increased about 100 per cent., so that the wires would generate twice as much E. M. F. as before but would only be generating E. M. F. about half the time in each revolution.

(To be continued).

A Rat Did It.

A rat roaming about in the City Electrical Light Works of Baltimore on Friday of last week, played havoc. While investigating behind the station switchboard he stepped from one brass terminal to another, with his front feet on one pole and his hind feet on the other, thus being subjected to 2,700 volts. In an instant there was a flash, a heavy ironstone piece of insulation was smashed, the network of wires blazed up, setting fire to the wooden frames of the switchboard, and hundreds of houses in the down-town streets were plunged in darkness. The hair of the rat was completely burned off and the body became rigid as if suddenly frozen in the act of stepping across the terminals. Although the hair was burned off and even the skull bone protruded, the body being instantly carbonized and rendered rigid, its attitude, when discovered, was life-like and exactly that of a rat stepping accross a small cavity. If the remains are not yet disposed of, Dr. Gibbons would probably consider it a favor to have them forwarded to him for resuscitation.

A Triumph of Electricity Over Gas.

According to London *Electricity*, the Heckmondwike Gas Works has installed an electric light installation to illuminate the purifying shed without the dangers which the use of the ordinary gas light exposes the place to.

Practical Notes on Dynamo Calculation—XX.

BY ALFRED E. WIENER.

36. Total Flux to be Generated in Machine.

The *total flux* to be generated in any dynamo is the product obtained in multiplying its *useful flux* by the factor of its *magnetic leakage*:

$$\Phi' = \lambda \times \Phi = \lambda \times \frac{6 \times b \times E \times 10^9}{K \times N} \quad \ldots\ldots(109)$$

Φ' = Total flux to be generated in machine, in lines of force;

Φ = Useful flux necessary to produce the required E. M. F. under the given conditions, from formula (91);

λ = Factor of magnetic leakage (see chapters 37 to 40).

The value of the total magnetic flux in a dynamo directly determines the sectional areas of the various portions of the magnetic circuit in the frame (see Part III.), and since the magnetomotive force required depends upon the total magnetic flux to be effected, has a direct influence also upon the magnetic winding. In calculating a dynamo-electric machine, therefore, it is of great importance to compute the actual value of the total flux, and, consequently, to predetermine with sufficient accuracy the amount of the magnetic leakage.

But since the dimensions of the magnetic circuit depend upon the total flux to be generated, the accurate value of the total flux, however, is given by the co-efficient of magnetic leakage, which, in turn, for a newly designed machine is to be calculated from the dimensions of the magnet-frame, it is necessary to proceed as follows:

An approximate value of λ for the type and size of dynamo in question is taken from Table LII., chapter 40, and the corresponding approximate total flux calculated from formular (109) With the value of Φ' thus obtained the principal dimensions of the magnet-frame are determined according to the rules given in Part III. The dimensions now being known, the probable leakage factor, λ, can be figured from formula (110), or (111,) respectively, chapter 37, the single terms of which are found by applying the formulæ and rules given in chapter 38 and 39 to the particular type under consideration. From formula (109), finally, the accurate value of the total flux is obtained. Should the latter prove so much different from the assumed aproximate value of Φ', as to necessitate a change in the dimensions of the frame, then the calculation of λ will have to be partly or wholly repeated.

That such a calculation of the probable leakage factor is necessary in every single case, is evident from the fact that not only the leakage in two machines of same general design, and even of approximately the same size, which are merely differently proportioned in their essential parts, may widely differ from each other, but that in one and the same dynamo the amount of the leakage can be considerably varied by using armatures of different core-diameters in its magnetic field.

From the same reason it can also be concluded that the method of assuming a valve of λ from previous experience with a certain type or even with an individual machine, is an entirely unreliable one, and that the calculation of the magneto-motive force based upon such an assumption cannot be depended upon.

The author's method of predetermination of the magnetic leakage from the dimensions of a machine to the process of calculation, to within but a few per cent. of the actual value, is given in the following chapters 37, 38, and 39. Prof. Forbes.*

Logarithmic formulæ 2, heretofore employed for the computation of the magnetic leakage, being too cumbersome for the practical electrical engineer, the writer believes that by his set of simple geometrical formulæ contained in chapter 38, he has removed some of the difficuty experienced in leakage calculations.

37.—Formula for Probable Leakage Factor.

Since air is a conductor of magnetism, the conditions of the magnetic circuit of a dynamo-electric machine resemble those of a closed metallic electric circuit immersed in a fluid. In the latter case, the main current will flow through the metallic conductors, but a portion will pass through the fluid. Similarly for the magnetic circuit, the main path for the magnetic flux being the magnetic circuit of the dynamo, consisting of the iron field-frame, the air gaps and the armature body. The amount of electric current passing through the surrounding medium, the fluid, depends upon the ratio between the conductances of the main to the shunt paths. In order to calculate the amount of magnetic leakage in a dynamo, therefore, it is, analogically, only necessary to determine the ratio between the permeances of the useful and the stray paths.

The leakage factor in any dynamo having a *smooth* armature

*Geo. Forbes, Journal Soc. Telegraph, Engineers, XV., p. 531, 1886.

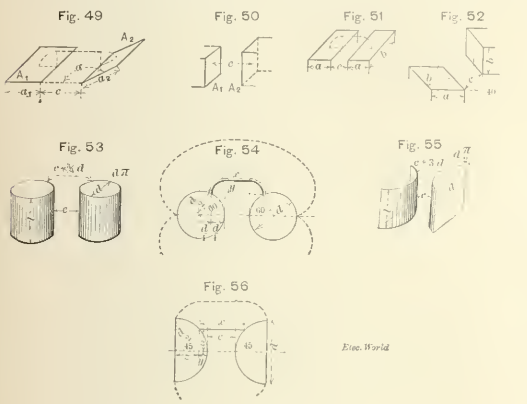
can accordingly be expressed as the quotient of the total joint permeance of the systems by the permeance of the useful path. But since the reluctance of the iron portion of the main path is very small compared with that of the air-gaps; the sum of their reciprocals, that is, the total permeance of the useful path, is practically equal to the permeance of the gaps; hence, the permeance of the gaps can be taken as a substitute of the permeance of the whole magnetic circuit within the machine, and we obtain the following formula for the probable leakage factor of any dynamo having a *smooth* armature:

$$\lambda = \frac{\text{Joint permeance of useful and stray paths}}{\text{Permeance of useful path}}$$

or,
$$\lambda = \frac{P_1 + P_2 + P_3 + P_4}{P_1}, \dots\dots\dots\dots\dots (110)$$

where P_1 = Relative permeance of the air-gaps (useful path);
P_2 = Relative average permeance across magnetic-cores .... } (stray paths).
P_3 = Relative permeance across polepieces.....
P_4 = Relative permeance between polepieces and yoke.........

The relative permeances by which are understood the absolute permeances divided by the magnetic potential, and which, therefore, include a constant factor, on account of the units chosen. are taken for conveniences, for in each individual case the maximum magnetic potential is the same for all permeances and a constant



FIGS. 49, 50, 51, 52, 53, 54, 55 AND 56.

numerical factor, if absolute permeances were used. would be common to all terms in (110), and consequently would cancel.

In order to obtain the probable leakage factor for toothed and perforated armatures, the "factor of armature leakage," (chapter 8) is to be introduced, and we have for this case:

$$\lambda' = \lambda_1 \times \lambda = \lambda_1 \times \frac{P_1 + P_2 + P_3 + P_4}{P_1} \dots\dots\dots (111)$$

Numerical values of λ, for various kinds of armatures are given in Table XI, chapter 8.

38.—General Formulæ for Relative Permeances.

In order to obtain the values of the permeances of the various paths, we start from the general law of conductance:

$$\text{Conductance} = \left\{ \begin{matrix} \text{conductivity} \\ \text{of medium} \end{matrix} \right\} \times \frac{\text{Area of medium}}{\text{Distance in medium}},$$

so, in our case of magnetic conductance:

$$\text{Permeance} = \text{Permeability} \times \frac{\text{Area}}{\text{Length}}.$$

Since the permeability of air = 1, the relative permeance between two surfaces can be expressed by the general formula:

$$P = \frac{\text{Mean area of surface exposed}}{\text{Mean length of path between them}}, \dots\dots (112)$$

From this, formulæ for the various cases occurring in practice can be derived.

(*a*.)—*Two plane surfaces, inclined to each other.*

In order to express, algebraically, the relative permeance of the space between two inclined plane surfaces, Fig. 49, the mean path is assumed to consist of two circular arcs joined by a straight line tangent to both circles, said arcs to be described from the edges of the planes nearest to each other, as centres with radii equal to the distances of the respective centres of gravity from these edges.

Hence.

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{c + \frac{a_1 + a_2}{2} \times \frac{\pi}{2} \times \frac{\alpha}{180}} \dots\dots\dots (113)$$

where A_1, A_2 = areas of magnetic surfaces:
c = least distance between them;
a_1, a_2 = widths of surfaces A_1 and A_2 respectively;
α = angle between surfaces A_1 and A_2.

(*b*.)—*Two parallel plane surfaces facing each other.*

If the two surfaces A_1 and A_2, are parallel to one another, Fig. 50, the angle closed is $\alpha = 0°$, and the formula for the relative permeance, as a special case of (113) becomes:

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{c} \dots\dots\dots\dots\dots\dots (114)$$

(*c*.)—*Two equal rectangular surfaces lying in one plane.*

In case the two surfaces lie in the same plane, Fig. 51, they enclose an angle of $\alpha = 180$ and the permeance of the air between them, by formula (113), is

$$P = \frac{a \times b}{c + a \times \frac{\pi}{2}}, \dots\dots\dots\dots\dots\dots (115)$$

a = Width of rectangular surface;
b = Length " "
c = Least distance between surfaces.

(*d*.)—*Two equal rectangles at right angles to each other.*

If the two surfaces are rectangular to each other, Fig 52, the angle $\alpha = 90°$, formula (113,) consequently, reduces to

$$P = \frac{a \times b}{c + a \times \frac{\pi}{4}} \dots\dots\dots\dots\dots\dots (116)$$

(*e*.)—*Two parallel cylinders.*

In case the two surfaces are cylinders of diameter d, and length l, Fig. 53, the areas of their surfaces are $d\,\pi \times l$; and if they are placed parallel to each other, at a distance, c, apart, the main length of the magnetic path is $c + \frac{3}{4}\,d$; hence the permeance of the air between them:

$$P = \frac{d \times \pi \times l}{c + \frac{3}{4}\,d} \dots\dots\dots\dots\dots\dots (117)$$

In this formula the expressions for the mean length of the path is deduced from Fig. 54, in which it is assumed that the mean path consists of two quadrants joined by a straight line of length c, and extends between two points of the cylinder-peripheries situated at angles of 60° from the centre line.

Since in an equilateral triangle the perpendicular, dropped from any one corner upon the opposite side, halves that side, the perpendicular, from either of the end points of the mean path upon the centre line, bisects the radius of the corresponding cylinder-circle, and the radius of the leakage-path quadrant is $y = \frac{d}{4}$, hence the length of the mean path:

$$x = c + y \times \pi = c + d \times \frac{\pi}{4},$$

or, approximately: $x = c + \frac{3}{4}\,d$.

This approximation even better meets the practical truth, as most of the leakage takes place directly across the cylinders, and the mean path, therefore, in reality is situated at an angle of somewhat less than 60°, which was taken for convenience in the geometrical consideration.

(*f*.)—*Two parallel cylinder-halves.*

If two cylinder-halves face each other with their curved surfaces, Fig. 55, the mean length of the magnetic path is $C + .3\,d$, where c is the least distance apart of the curved surfaces, and d the diameter of the cylinders, and we have for the permeance:

$$P = \frac{d \times \frac{\pi}{2} \times l}{c + .3\,d} = \frac{d \times \pi \times l}{2\,c + .6\,d} \dots\dots\dots\dots\dots (118)$$

The mean length of the path is geometrically found from Fig. 56, as follows:

$$2\,z^2 = \left(\frac{d}{2}\right)^2 : z = \frac{d}{2}\sqrt{\frac{1}{2}}$$

$$\therefore y = \frac{d}{2} - z = \frac{d}{2}\left(1 - \sqrt{\frac{1}{2}}\right) = .15\,d$$

$$x = c + 2\,y = c + .3\,d$$

For in this case, the extent of the leakage-field is much smaller than in that of full cylinders, and the mean-path can be assumed a straight line meeting the two semi-circles at an angle of 45° from the centre line.

(To be continued.)

The Architect and the Electrical Engineer.

BY KEPPELE HALL.

The now almost universal practice of providing new buildings with interior conduits, and wires for lighting by electricity, seems to afford an opportunity for a few words in regard to the relation between the architect and the electrical engineer.

The writer has been led to a consideration of this question by the fact that a goodly proportion of the specifications drawn by architects for electric light and power installations are very faulty, allowing the contractor to perform poor work in many instances; in others, to require an unnecessarily expensive outlay, which has to be borne by the owner; and in the majority of cases, leaving the contractor a margin for "extras" which is alarming.

There is a great deal of competition in electrical construction work, and in competitive bidding the large firms and the small ones have learned that in order to secure a contract they must cut down the margin of profit to the lowest possible limit. The result is obvious. Give a contractor a set of specifications loosely drawn up. He cannot afford to put in an estimate covering defects in them, as then his bid will be too high. Accordingly, he bids in "conformity to specifications," and before his work is good enough to give any kind of satisfaction or pass the inspection of the Underwriters' Associations, the owner must pay for "extras" 15, 20 or even as high as 50 per cent. more than the contract has been awarded for.

There are architects who regularly employ engineers to draft specifications for them, and this is as it should be, but a great many use one specification over and over again, adapting the same to different conditions. In electrical wiring it very seldom happens that two or more cases are identical. We have had specifications calling for "no more than 3 per cent. drop from mains to any lamp when all are burning," and yet no mention of the number of lights per outlet, leaving the bidder at a loss to know whether to calculate for No. 0 or No. 14 wire.

Others, showing markings and corrections that indicate clearly that the same copy has been used for a number of different cases, call for location of cut-out boxes in the most unsuitable places, because in a different building for which the specifications were originally drawn that place was the most advisable; and demanding provision for the "three-wire system" in towns where there is not the remotest possibility of its ever being used.

These are but few of the defects that could be pointed out. The gist of the matter is easily seen. The architect is not an electrician, nor is he capable in most cases of superintending a piece of electrical work which needs expert surveillance. The owner should insist upon having his work done under the supervision of an electrical engineer, whose practiced eye will avert or detect defects in workmanship and materials, which otherwise will remain unnoticed until too late and cause no end of trouble and expense.

Symbols and Abbreviations.

To the Editor of The Electrical World:

Sir:—We notice, in your issue of the 1st of December, an extract from the London Electrical Review of the 16th November, containing some editorial remarks concerning the symbols and abbreviations recommended by the Committee on Notation, of the Chamber of Delegates, of the Chicago International Electrical Congress of 1893. The editor urges the following objections against the general adoption of these symbols and recommendations; namely,

(1.) That there is no valid reason for prefering script to block letters for symbols.

(2.) That time would be saved to the large army of professors and lecturers by the employment of **M** and **H** instead of the troublesome French script.

(3.) That to employ French script would mean learning a new alphabet.

(4.) That the block letters have been, and are being, used by nearly all the leading writers on magnetism at the present time.

(5.) That the word "intensity" has no meaning in the English language, as applied to the strength of electric current, and that, therefore, the initial letter I should not be used to replace C.

(6.) That the American Institute of Electrical Engineers has, by the adoption of the symbol, $C = \frac{E}{R}$, upon the Institute badge, tacitly censured the recommendations of the Congress Committee.

Replying to these, seriatim, we would say,

(1.) We acknowledge that there is no apparent reason for preferring script to block letters, unless it be that block letters are generally used to designate vector quantities, and that not all the magnetic symbols stand for vector quantities.

(2.) The question here would appear to us whether the amount of time that might thus be saved, would not be more than offset by the necessity which would exist for learning and explaining the different symbols otherwise employed in different countries.

(3.) The argument that the use of the French script would necessitate the learning of a new alphabet necessarily falls, since an inspection of the symbols proposed discloses the fact that but seven symbols are printed in script, so that these seven only would require to be learned, and not an entire alphabet.

(4.) While it is true that in many leading text-books on the subject of magnetism block letters are employed, yet these books had nearly all been written before the session of the Congress Committee.

(5.) It is true that the word intensity of current would require to be explained to the student, to show the application of the symbol I, instead of C, for current strength.

(6.) The American Institute of Electrical Engineers adopted the symbols on its badge before the session of the Chicago Congress, and there is no record of any action taken by the American Institute upon the subject.

It seems to us that it is not a question as to what particular set of symbols would be best suited to the language of any one nation, but rather how much greater a degree of advantage would be secured by the sacrifice of some individual preference or advantage, for the sake of universality of notation. The advantage of an international system is, of course, to be found in the fact that it creates an international language, and that any local inconvenience that must necessarily arise in such compromise, would be more than off-set by the convenience and simplicity secured.

In order to meet this international adjustment, the French have apparently been willing to introduce a new letter into their technical alphabet, by the use of W for electrical energy, and, in the same way, each language has suffered to some extent by the system of symbols proposed. We surely owe something to France, if only for the creation and introduction of the decimal metric system, the foundation of the C. G. S. system, and, while therefore we would prefer to have C, instead of I, as the symbol for current strength, yet we consider that the disadvantage of the symbol I will be more than offset by the advantage of the international co-operation in electrical engineering symbols and abbreviations..

We earnestly hope, therefore, that the recommendations of the Congress Committee may meet with cordial support in all parts of the world where electric engineering is carried on; for unity of notation is a step towards progress, amity and civilization.

EDWIN J. HOUSTON AND A. E. KENNELLY.
Laboratory of Houston & Kennelly,
Philadelphia, Pa.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir: As one way of preventing the danger of fly-wheels bursting through the cause suggested by Mr. R. Fleming (in your issue of Nov. 24th), that is, by a generator being reversed and for the time converted into a motor which might run away with the engine, I would suggest an automatic cut-out as follows: Place in a shunt across the dynamo terminals an electric magnet having a polarized armature. Connect in such a way that when the direction of current is normal in the dynamo; the magnet will attract its armature, so preventing any jar or other cause from operating the cut-out. Should, from any cause, a current be sent through the dynamo in the reverse direction, the magnet armature would be at once repelled and forced against a back contact, closing a circuit through an electro-magnet, which would release a spring circuit breaker, thus opening the dynamo circuit Such a circuit breaker would not interfere with an ordinary overload breaker, since it only acts as a reversal of the current. With such an arrangement it would be impossible, so long as it was in working order, to keep the dynamo in circuit, when not generating. A. H. BURNETT,
Englewood, N. J.

Resistance of the Human Body.

The much vexed question of the resistance of the human body has been solved, it is said, by a Frenchman, who states that its resistance when placed in a bath of water is slightly greater than that of the volume of water which it displaces

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Cold Light.—A long editorial on "An Outstanding Problem" in the Lond. "Elec.," Nov. 16, discusses this subject in an interesting way but without giving any data; it states that the problem is really that of exciting definite single waves of radiation, imple waves of one given wave length; the statement "light without heat" is claimed to be erroneous and should be "light without unnecessary heat;" what is really desired is to be able to transform any amount of non-radiant energy into an equal amount of radiant energy of an absolutely controllable character as regards wave length; the difficulties in controlling such wave lengths are discussed and are said to be greatest in solids and liquids and least in gases; "it is in the fewness of molecules and the simplicity of molecural structure that the hope of solving the problem mainly appears to lie." Two lines of research are open, the first and chief one, which seems most likely to yield the best results, is to excite definite radiation by directly electrical means, and the second is in heating to incandescence solid bodies which possess an abnormally high coefficient of emissivity. Experiments seem to show that it is not impossible to reduce the molecular structure of a substance whether of solid or gas to such a condition that it will emit an abnormally large proportion of luminous radiation, and if so, one of the practical phases of the problem is to contrive to stimulate radiations, and if possible to make that molecular condition permanent.

Light from High Frequency Currents.—Mr. Guillaume in "L'Ind. Elec.," Nov. 10, gives a good description of the recent researches of Prof. Ebert (see Digest, Oct. 6, and Electrical World, Nov. 3, p. 467); the article appears to contain little that has not been included in these references, except the illustrations which include that of the condensers and coils.

Phosphorescence of Incandescent Lamps.—A writer to the "Elek. Zeit.," Nov. 15, states that with a certain lamp he found that on attempting to put it into the socket it phosphoresced sufficiently for one to see the whole lamp distinctly and even see the hands of a clock near the lamp; he believes that it was caused by the rubbing of the bulb by the hand; the same thing was tried with a number of other lamps but only one was found which could be made to phosphoresce. Another writer to the Journal says the information is not sufficient to explain the cause; he believes that it is due to one pole of the lamp being connected to the circuit of which the other pole was grounded, thus producing a difference of potential of 100 volts between the filament and the hand and that the lamp probably had a bad vacuum and one at which the conductivity of the rarefied gases was at a maximum.

Conductivity of Solutions.—In connection with the conductivity of aqueous solutions, in which a portion is replaced by a non-electrolyte, the Lond. "Elec. Rev.," Nov. 16, calls attention to a paper by Mr. Strindberg from the "Zeit. feur Phys. Chem.," vol. 14, page 161, whose results agree with those of Arrhenius, whose formula is given, but differs from those of Holland.

Potential Determinations.—Some abstracts from a paper by Mr. Neuman from the "Zeit. feur Phys. Chem.," vol. 14, page 193, are given by the Lond. "Elec. Rev.," Nov. 16; they refer to the estimation of the potential of hydrogen and some of the metals.

Dielectrics.—A French Academy paper by Mr. Pellat on the force acting at the surface of separation of two dielectrics is reprinted in "L'Ind. Elec.," Nov. 10; in the general case the force is normal to the surface of separation and in the direction in which the specific inductive power diminishes.

Thermo-electric Force Between Electrolytes.—Mr. Bagard's paper from the "Ann. de Chim. Phys.," September, 1894, mentioned in the Digest, Nov. 17, is abstracted at some length in "L'Eclairage Elec.," Nov. 3.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Influence Machine.—An improvement by du Rocher is described in "L'Elec.," Nov. 10; its object is to enable one to increase or diminish and therefore to regulate, the output of such a machine; it consists in the use of special condensers of small capacity, having only one pole, the air forming the second pole; one form of these condensers consists of a bulb containing a metallic filament connected with an exterior piece of metal for forming contact, a Crooke's vacuum being formed in the bulb; this bulb is placed in the electric field of a machine and is connected with one pole; such condensers, if of small volume, increase the voltage of the machine and those of large capacity increase the output considerably; by connecting and disconnecting them the voltage and the output may be regulated; the system is based on Faraday's theorem, that when an electrolyzed body is completely surrounded by a conductor there is produced by induction on the interior of this conductor a charge equal and of opposite sign to that of the electrified body; the theorem may be demonstrated by taking metallic cylinders connected to the machine and surrounded by cylinders of celluloid which are preferable to glass; such a system is charged like the condensers above mentioned, but it is incapable of replacing these.

Standard of Light.—The article by Mr. von Hefner-Alteneck, abstracted in the Digest, Sept. 29, written in defense of his standard, is abstracted in the Lond. "Elec.," Nov. 16. A brief description of the Reichsanstalt standard (see Digest, June 2 and Sept. 22) is published in the Lond "Elec. Rev.," Nov. 16. (In regard to the standard proposed by the Reichsanstalt, attention is here again called to an important criticism by Mr. Guillaume abstracted in the Digest, June 9 and 16.)

Pupilometry and Photometry.—In "L'Eclairage Elec.," Nov. 3, Mr. Henry begins an article on this subject, the present portion being on a new law for the contraction of the pupil; he describes some new researches in this direction.

Symbols and Abbreviations.—The Lond. "Elec. Rev.," Nov. 16, replies editorially to Prof. McFarlane's letter (see The Electrical World, Oct. 27, p. 446); the full reply is published on page 568 of the present issue.

TRANSFORMERS.

Principles of Transformer Design.—The article by Mr. Still is continued in the Lond. "Elec.," Nov. 16. He discusses the wattless and hysteresis components of the magnetizing current, representing them with diagrams; also the maximum and mean values of the current and E. M. F. Regarding choking coils he gives the following formula:

$$E = \frac{4.44\ N\ n\ T}{10^8}$$

by the aid of which a choking coil may be designed to give any required back E. M. F.; E represents the square root of the mean square value of the E. M. F., M the maximum value of the magnetization, that is the number of lines in C. G. S. units, n is the frequency and T the number of turns of wire in the coil; the number of volts is not equal to the difference between that of the circuit and that to which it is to be reduced, but is equal to the square root of the difference between their squares, which gives a considerably greater value; he adds that it is probable that the closed magnetic circuit is not suitable for cutting down the voltage from 100, for instance, to that required by an arc lamp and that a small air-gap in the magnetic circuit may be an advantage; for calculating N he gives the following empirical formula for the ampere turns required per inch length of the iron circuit and applies to a very good quality of transformer iron

$$\text{Amp. turns per inch} = \frac{\mathfrak{B}}{10{,}000} + 2$$

in which $\mathfrak{B}$ is the induction in the iron in lines per square inch; for the average quality of iron the formula

$$\frac{\mathfrak{B}}{9{,}000} + 3$$

is perhaps more generally useful. These apply to cases where lies between about 12,000 and 40,000 and are based on the assumption that the curve connecting the exciting force and induction is a straight line between these limits; for air he gives the formula

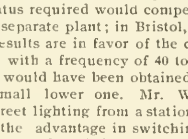
$$\text{Amp. turns per inch} = 0.313\ \mathfrak{B}$$

which is true for all values of $\mathfrak{B}$. For calculating T it is generally sufficiently accurate to assume that the maximum current is 1.4 times the square root of the mean square. He then discusses transformers, first for an open and then for a closed secondary circuit; in the former case the wattless component is obtained by dividing the maximum value, as given by the above formulas for the ampere turns, by 2.6, which is an empirical constant without any physical meaning and is found to be about right for the low inductions generally used for transformers, but for high inductions it may be many times greater than this; the hysteresis component is obtained by dividing the total open-circuit loss in watts by the E. M. F. in volts supplied to the transformer; the true magnetizing current is the resultant of these two currents, differing in phase by one quarter of a period. The power factor is the ratio of the true watts to the apparent watts on open circuit, the latter being the E. M. F. multiplied by the total magnetizing current; in a good transformer with closed iron circuit the power factor is generally about 0.7; a small power factor is no indication of low efficiency and effects only the loss in the mains.

ARC AND INCANDESCENT LIGHTS.

Continuous and Alternating Current Arcs.—A discussion of Dr. Fleming's article abstracted in the Digest Nov. 17, is published in London "Lighting," Nov. 8 and 15, the discussion having been contributed since the recent publication of that paper. Mr. Crompton thinks the tests are satisfactory and the results conclusive except in that it is not stated whether the same quality of carbons was used for both classes of arcs; he himself has obtained efficiencies somewhat higher than these; he believes that if carbons are specially prepared for the alternating arc and if somewhat higher voltage is used in this, much better comparative efficiencies will be obtained; it is a well-established fact that small alternating arcs are to be avoided, below 12 to 15 amperes they exhibit the defects in an exaggerated manner; it is difficult for the manufacturer to keep arc lamps in stock as they depend on the particular kind of current used. Mr. Preece criticises the paper unfavorably, stating that the experiments were made when alternators were very poor as compared with those of to-day, and he thinks the conclusions might be different if the experiments were repeated at the present time; to use one and the same form of lamp for both is the very thing which gives improper, imperfect and misleading results; he does not favor the use of the colored screens; he suggests that the use of an adjustable choking coil in series with the arc would have stopped the fluctuations which he spoke of; he believes that the facts observed lead to different conclusions from those deduced by Dr. Fleming, and he does not think they show any general inferiority of the alternating lamp; he believes that the same energy expended in the arc, may, if the conditions are the proper ones, be equally effective in practice. Mr. Raworth thinks that one of the vital questions is the value of the illumination at the points equally distant between the two lamp posts, and that it is immaterial whether there are a few hundred candles more or less at an angle of 40 to 50 degrees. Mr. Uppenheimer states that although cored carbons are more expensive, the fact was overlooked that with alternating currents carbons of smaller diameter may be used for the same current, and the cost therefore will be identical or even less; he states that it cannot be maintained that the attaching of a reflector close to the arc introduces complications, as this has been in use for a number of years. Mr. Hesketh objects to the direct current system on account of the complicated nature of the generating plant and its untrustworthiness; the plant takes up valuable space and requires extra labor, repairs being frequently necessary; he favors using only one type of generating plant; he thinks alternating arcs of 15 to 18 amperes will come into favor; rectified currents will prove the most serious opponents to alternating currents for public arc lighting. Mr. Proctor thinks the results for alternating currents may be greatly improved by proper proportioning; the advantage of separate series system is that all the lights may be turned on or off at the same time from the central station; he believes that the street and private lighting systems should be kept entirely separate, and that a saving of the apparatus required would compensate for the increased capital outlay for the separate plant; in Bristol, where both of the systems are in use, the results are in favor of the continuous current. Mr. Stewart suggests that with a frequency of 40 to 50, very much better results in the efficiency would have been obtained; he recommends a large upper carbon and a small lower one. Mr. Wright does not favor a separate system for street lighting from a station using alternating currents, and he thinks the advantage in switching on the lamps from the station have been overrated, as it is necessary in any case to send an inspector to examine the lamps.

Increasing the Life of Carbons.—An apparatus identical with the one described in the Digest, Nov. 3, but under another name, is described and illustrated in the "Elek. Zeit.," Nov. 15; the principle of it is to surround the lower end of the upper carbon with a hood open at the bottom so as to keep the point of the carbon surrounded with an atmosphere of the products of combustion. The apparatus is shown in the adjoining cut; the large hood is hollow and the upper carbon passes



ARC CARBON ECONOMIZER.

through it but does not project; the whole apparatus is carried by the lower carbon by means of the three platinum points which rest on the conical surface, and it therefore feeds down automatically as the lower carbon is consumed; the nuts on the side enable the apparatus to be adjusted; the results of a series of photometric and efficiency tests made at an institution in Vienna, are given, and show that the amount of light given off is practically the same with or without this apparatus; when the end of the upper carbon is on a level with the bottom of the hood there even is an increase of 6 per cent. in the light; the hourly consumption of the upper and lower carbons was 14.1 and 15.5 millimeters respectively, when the apparatus was not in use, and 4.9 and 10.0 respectively when the apparatus was used; it appears that the only part which needs to be replaced is the hood, which lasts about 500 to 800 hours.

Poles for Arc Lamps.—A system is described and illustrated in the "Elek. Zeit.," Nov. 8, in which the lamp is suspended over the top of the pole but can readily be lowered down on the side; the pole, therefore, does not cast a shadow.

Illumination.—In the serial of Messrs. Pentland & Gibbings in London "Electricity," Nov. 16, the subject of illumination is discussed, with a view to show how the position, number and candle-power of lamps is to be determined; the terms luxes, photes and lumens are used as units, the latter representing photes per square foot per second.

Incandescent Lamp.—The serial from the French, by Mr. Bainville is continued in the Lond. "Elec. Rev.," Nov. 16. A short summary of the serial is published in the Lond. "Elec. Eng.," Nov. 16. The original is continued in "L'Elec.," Nov. 10.

Cored Carbon Litigation.—The "Elek. Zeit." Nov. 8, publishes some information regarding the recent litigation in Germany.

ELECTRIC RAILWAYS.

Traction—"L'Ind. Elec.," Nov. 10, publishes at some length the first part of an interesting article by Mr. Pellissier, in which he discusses the various traction coefficients, the present portion being devoted to rolling friction, curves, air resistance, grades and starting. The article is in general a compilation of published matter and contains numerous constants and results of experiments, taken almost entirely from American sources, and therefore giving little if anything new, although the matter compiled is of considerable value. Regarding the recovery of energy on a down grade, he states that on the electric rack road at Barmen about one-third of the energy required on ascending is recovered on descending.

Street Railways in Budapest.—According to the "Elek. Zeit," Nov. 15, all the horse car lines in that city are to be transformed into electric lines; those in the dense part of the city are to be constructed like those at present in use there, with a conductor in a slotted underground conduit, while those in the outlying districts are to be run as trolley lines; the milage of the horse car lines at present is 27.6, carrying 350 cars; the change is to be completed during the next year, and is to be carried out by the firm of Siemens & Halske; by means of a special construction the cars will be able to run from the conduit portion to the overhead portion without delay in making the change. The construction of the underground line is progressing faster than was anticipated, and it is thought that it will be completed during the fall of next year.

Electric Traction.—The paper mentioned last week by Messrs. Blackwell and Dawson, is continued with a large number of illustrations in the Lond. "Elec.," Nov. 16.

Electric Traction in Germany.—Some figures from a book recently published by the General Electric Company of Berlin, regarding ten important roads in Germany, are given in the Lond. "Elec. Rev.," Nov. 16.

Accumulator Traction in Paris.—A brief description, with illustrations of the cars, is published in "Ind. and Iron," Nov. 9.

Municipal Purchase of Tramways.—A discussion by a deputation from the Tramways Institute is published in the Lond. "Elec.," Nov. 16.

Light Railways.—An article from the London "Times" is reprinted in the Lond. "Elec.," Nov. 16.

Electric Railroad on Ice.—According to the "Elek. Zeit.," Nov. 15, a winter electric road is to be constructed in Finland over the ice covering a body of water. The speed is to be 13.6 miles per hour.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

The Future of Central Stations.—A lecture by Mr. Ferranti on the electrical developments of the future is published in London "Lightning," Nov. 15. He discusses the possible improvements in the near future in the generation of electricity and the effects realized if electrical energy is cheap. Regarding the improvements in central stations he thinks the solution of cheap motive power is to be found in the gas engine; he thinks it will be possible in the future to increase the productive power of a given amount of capital expenditure in central stations ten times; electricity should be produced at about one-fifth the amount of coal now used; when running continuously the energy might be produced for one-third the amount of coal that is required when the load is a varying one; an improved load factor will be the result of a cheaper supply; higher pressures than those employed to-day will be used; he considers the charging system at Brighton, in which the Wright "demand meter" is used, is an excellent one, as it gives the consumer who uses current for a large number of hours an advantage over the one who uses a large number of lights for a few hours only; he also recommends the system at Bolton, in which the central station undertakes to do the wiring and fitting for the consumers on the hire-purchase system; he puts stress on making the electric light popular.

Rectifier.—A new form which dispenses with commutators, and suggested by Mr. McElroy, is briefly described in "Ind. and Iron," Nov. 9; the description, however, is not very clear; it consists of "an indicator alternator, which has two pairs of magnets and coils and an indicator armature having only half the number of teeth corresponding with the pitch of the magnets;" it appears that a counter E. M. F. is produced in certain coils which will prevent the current flowing through

them. It is admitted that the efficiency would not be as high as in a commutator rectifier.

Lighting Installations.—A paper by Mr. Henderson is published in the Lond. "Elec. Eng.," and "Elec. Rev.," Nov. 16; he discusses installations which have not passed the examination of the supply companies' inspector.

Electricity from Gas.—The Lond. "Elec. Eng.," Nov. 16, illustrates and describes briefly the system of Mr. Thwaite, fuller details of which are promised later, of a steam coal gas generator for driving gas engines; he claims that there will be considerable saving in coal by converting the coal into gas and using it in gas engines instead of using it for steam engines.

Current Indicator.—A simple device for indicating reverse current in accumulator circuits or when dynamos are connected in parallel, is described and illustrated in the "Elek. Zeit.," Nov. 8.

Hampstead.—A description with a number of illustrations is published in the Lond. "Elec. Eng.," Nov. 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone.—A new form by Mr. Ohensorge is described in the "Elek. Anz.," Nov. 8. It consists of a coil having a movable core, one end of which is attached to the membrane, the core consisting of a spiral of iron wire; it is said that such telephones are extremely light and are precise in their action, but heretofore they have not been sufficiently loud; he finds that the loudness is increased very greatly when only a part of this spiral projects into the opening in the coil; the loudness is still further increased if the spiral is made of hardened magnetized steel and it will then serve also as a transmitter.

Domestic Telegraph and Telephony.—An improved system for hotels and large buildings is described and illustrated in the "Elek. Zeit.," Nov. 8.

Fire in a Telegraph Building.—The "Elek. Zeit.," Nov. 15, describes a recent fire in a German télegraph building in which considerable damage was done.

Block System.—The Tyer's electric system is briefly described and illustrated in the Lond. "Elec. Rev.," Nov. 16.

ELECTRO-CHEMISTRY.

Electricity Direct from Coal.—The paper by Dr. Borchers, mentioned in the Digest, Nov. 17, is published in full in the Report of the German Electro-Chemical Society. He considers his experiments as only preliminary; the cell consists of oxygen in the form of air, carbonous oxide or generator gas, and an electrolyte of a solution of cupric chloride which absorbs both carbonous oxide and air equally well; as he desired to make the apparatus practical he could not use platinum electrodes but used copper instead for the pole at which the carbonous oxide is to be dissolved, that is for the anode; the retaining cell may therefore be made of copper and serve as one of the electrodes. An illustration of the apparatus used in the test is given as also the table of results; at short circuit 0.64 amperes was obtained and on open circuit a maximum of 0.56 volt; an acid solution gave better results than an alkaline one and the copper electrode should be covered with copper filings; theoretically the combustion of carbonous oxide should give 1.47 volts, the efficiency in these experiments for the conversion of coal into electrical energy was therefore 27 per cent. (this, however, appears to be based on the relation between the observed and the calculated voltage); if the gas also contained hydrogen and hydrocarbons the action would be still better; the combustion of coal into carbonic oxide should give about 2 volts; in his experiments 0.3 was obtained, giving an efficiency of only 15 per cent.; the use of coal is almost prohibitive on account of the frequent renewals of the solution which it necessitates; he concludes that the only promising method is therefore to convert the coal into gases and then use these gases in the battery. He describes and illustrates two proposed cells of a practical nature, one for using gas and the other for coal, but he has not yet tried them as they are not finished; they are based on the conditions given by Prof. Ostwald (see Digest, ——————); he concludes that the problem of the cold combustion of the gaseous products of coal and oil, in a gas battery and its direct conversion into electrical energy can certainly be accomplished and he thinks it will be done with apparatus somewhat like that which he describes. In the discussion Dr. Vogel discussed the question of efficiency and asked how much of the gas was consumed; Dr. Borchers replied that some would necessarily be lost, but that it is well known that the absorption of the gas in the liquid is rapid and complete and that the same gas may be passed through several cells. Dr. Nernst stated that some time ago he suggested the following indirect solution: to convert the chemical energy of the coal first into some other chemical energy and then this into electrical energy, as for instance, by using zinc and afterwards reducing the bi-product by means of coal; another suggestion is to construct an accumulator which will stand a very high temperature and has a great temperature coefficient; it would be charged at a very high temperature when its counter E. M. F. was low and would be discharged cold when the E. M. F. was high; he also suggests that the maximum possible efficiency is not known and that as much as 130 per cent. might be obtained by the simultaneous absorption of heat from the surrounding air.

Gas Battery.—"L'Eclairage Elec.,"Nov. 3, abstracts a Physical Society paper by Messrs. Colardeau & Cailleteton on the condensation of gases by platinum and other metals. Experiments were made with platinum sponge and it was found that the discharge was much more constant under a pressure of 50 atmospheres and over, up to 600; the efficiency of this apparatus as an accumulator was very high if the discharge follows the charge immediately, and it attained 95 to 98 per cent. (presumably in ampere-hours); the negative electrode must weigh three times as much as the positive, and under these conditions a capacity of 25 ampere-hours per pound of platinum was obtained, the current when constant was about 45 amperes per pound. Iridium gave similar results; ruthenium was slightly attacked; with palladium in the form of a sponge the capacity under pressure was 80 ampere-hours per pound, the positive electrode weighing twice as much as the negative; palladium absorbs 2,400 times its volume of hydrogen, or 600 volumes of oxygen; with gold sponge the results were similar to those with platinum; with the baser metals, including silver, and with carbon, the actions were different and it was found that there was a chemical action; they conclude that only the precious metals can be used for such accumulators and that therefore this method does not admit of practical application.

Million Battery.—"L'Elec.," Nov. 10, gives some data regarding this battery, in which the zinc is placed in an annular porous cup, containing sulphuric acid and the carbon plate is formed of rods, some of which surround the porous cup and others are surrounded by it, the zinc being therefore active on both sides; the depolarising solution is made of bichromate of soda in acidulated water. The E. M. F. on open circuit is 2.1 volts, with 10 amperes 1.8 volts, and it will give 100 amperes on short circuit; it has a capacity of 160 to 180 ampere-hours (the size of the element, however, is not given); five cells will run 20 lamps (candle-power not given) for five hours, the charge for which costs 10 cents per cell, including the zinc consumed; a few further figures are given for a small portable cell and for charging accumulators; it is stated that a tricycle operated by 8 cells can be run for 48 miles at a cost of 80 cents.

Leclanche Cells.—According to "L'Eclairage Elec.," Nov 3, Mr. Mechinel states that if the white deposit formed in Leclanche cells is boiled in double its volume of water, oxide of zinc of commercial value will be formed.

Bleaching Paper Pulp.—A new process by Mr. Abom is briefly described in the Lond. "Elec. Rev.," Nov. 16. The pulp is placed in a receptacle not attacked by chlorine and a solution of an alkaline chloride is added, after which a current is passed through it between carbon plates; after 20 to 40 minutes the current is stopped and the bleaching continues to any desired extent; care must be taken that the temperature does not rise too high or the hypochlorite will be converted into chlorate which possesses no bleaching properties.

Maximum E. M. F. for Electrolysis.—The Lond. "Elec. Rev.," Nov. 16, calls attention to a paper by Mr. Wiedeberg from the "Zeit. feur Chem.," vol. 14, page 174, the results of which practically negative the question of maximum E. M. F. in electrolysis; the author believes that for any given E. M. F. there is a certain corresponding pressure of the gaseous product, the formula for which is given, and therefore electrolysis is set up by any E. M. F. however small.

Limits of Electrolysis.—The paper by Mr Berthelot from the "Ann. de Chim. Phys.," September, 1894, is abstracted in "L'Eclairage Elec.," Nov. 3; he shows the agreement between measurements by different observers with entirely different methods, thus giving a striking experimental confirmation.

MISCELLANEOUS.

Elevator.—An illustrated description of an electric elevator used in Berlin, is published in the "Elek. Zeit.," Nov. 15; the drum is operated by a worm wheel driven by a 5-hp motor; it is intended to carry 1,100 lbs. with a speed of about 20 ins. per second; it includes an arrangement by which a brake is put into action automatically when the current is broken.

Practical Application of Ozone.—The paper by Dr. Froelich abstracted in the Digest, Nov. 17, is published in full in the Report of the German Electro-chemical Society.

Ruhmkorff.—A discussion of the spelling of this name has appeared in the Lond. "Elec.," and in the issue of Nov. 16 several correspondents show that in the original articles it is spelt "Ruhmkorff," thus leaving no doubt as to the correctness.

Electromagnetic Governor.—The Decombe system is described and illustrated in "L'Elec.," Nov. 10; the valve is opened mechanically but is closed by the electric device.

Alarm.—An apparatus to be connected with doors, cabinets, windows etc., to ring an alarm when opened, is described and illustrated in the "Zeit. feur Elek.," Nov. 1.

Alarm Clock.—An apparatus adapted to be attached to any clock, to ring an electric alarm at any predetermined time, is described in the "Zeit. feur Elek.," Nov. 1.

Antwerp Exhibition.—A descriptive article by Mr. Brunswick is published in "L'Eclairage Elec.," Oct. 27; it appears that the department "Electricity" was not very well represented; two large illustrations of three cylinder electric pumps are given; he states that the failure of the trolley balloon was not due to a failure in the electrical apparatus.

Biographical.—A biography of Helmholtz of some length, is published in the "Elek. Zeit.," Nov. 8.

New Book.

TRAMWAYS: THEIR CONSTRUCTION AND WORKINGS. By D. Kinnear Clark New York: D. Van Nostrand Co. 758 pages, 405 illustrations. Price, $9.00.

The note book of the experienced engineer, while containing valuable data, is in general a history of his work and the mistakes he has made. It is seldom that he uses the data without some modification or improvement. The work on tramways by D. Kinnear Clark is essentially such a note book, and by its history of what has been done it furnishes the data necessary to determine what to do. It is not a book describing methods of procedure and recommending different materials. It is rather a book of facts and figures on actual tramways, presented with but little comment. The data speak for themselves and the reader is left to draw his own inference. The book is divided into seven parts and an appendix.

Part 1 is a history of the origin and progress of tramways. While interesting as general reading it has a certain value in its collection of old ideas. The careful consideration of a collection of old ideas is one of the most fruitful sources of new ones.

The value of Part 2 is unquestionable. It is a collection of statistics of great value both to the stockholder and engineer. As Mr. Clark states in his preface the statistics are largely taken from the business records of the officials of the tramways mentioned, and, therefore, it would be hard to question them. So many examples are given that it is possible for the engineer to pick out one to fit his particular case. Among the data given are some not often found on managers' records, but none the less interesting. Almost any record will give net receipts and expenditures, fewer give mileage of cars and passengers carried, and it is seldom that a person is able to run across data on rates, taxes, tolls, compensation for personal injury, legal and parliamentary expenses, etc., and this too in the neighborhood of several hundred different cases. The classified tables of expenses per car per motor or per horse are very interesting. The fact that the most trivial items are listed and not blocked together under sundries, is evidence of the completeness of the data. This part is particularly interesting to stockholders and managers.

Part 3 takes up the construction of tramways. Illustrations of cross-sections of tramways and rails are frequent, and tables of cost per mile, not simply for the whole construction, but for excavating, filling, paving, ties, rails, spikes, bolts and tie plates. There are also given specifications for material, tests and prices of supplies, of excavating, filling and concreting per cubic yard from the schedule prices of contracts. The laying of tracks is described in detail. The method of mixing and composition of cements and concretes used, also the operations in their order. The drawings and cuts are to a given definite scale, which adds greatly to their value. This part comprises 242 pages, which gives an idea of its completeness.

Part 4 is devoted to tramway cars. Starting with the historical, it gives descriptions and working drawings of car bodies, trucks and suspensions. The inventor and designer will find them of great value. and a careful perusual of the drawings of suspensions, and trucks, would result in the design of a better street railway truck than is in general use to-day. To design a new truck is easy, but to design a good truck is more difficult, and it is as important to know what to avoid as what to construct. Such information can only be obtained by careful perusal of existing forms and their performance, and these data are given in this book.

Part 5 is devoted to mechanical power on tramways. It is noticeable that here, as all through the book, where a fact is to be established or a principle demonstrated, the author turns not to a mathematical proof or theoretical deductions, but to the data on a practical existing case. Not simply steam-power but compressed air and cable traction are discussed, accompanied by copious tales of data, drawings and illustrations.

Part 6 discusses electric traction and has great historical value, and shows how step by step the progress has advanced. Expert tests of actual roads are given, and reveal where the power goes to and in a measure why it goes there. The data and descriptions are always exhaustive. Pole and line construction is discussed and data which is difficult to obtain, but none the less important, is included in the tables given.

Part 7 comprises supplementary chapters on special motors, namely: oil and gas. Data with regard to these motors is exceptionally difficult to obtain. The appendix comprises parliamentary and official regulations, and is useful to the promoter as giving the legal obstacles he is likely to meet.

The whole book has a value to any one interested in tramways, and is a useful addition to the library of the engineer, capitalist or promoter.

A New Car Controller.

A new car controller has been perfected by Edward F. Edgecumbe, 60 Elm street, Lynn, Mass., which, it is claimed, is in many respects quite a departure from present practice and a step in advance. Among its features are a quick break of contacts, and the current carrying parts liable to arc are immersed in an oil bath. The operating handle also puts on an electric brake when desired, but this cannot be put on until the current is shut off. The reversing switch is interlocking so that it cannot be changed while the current is on. The motors and the main operating handle cannot be moved forward until the reversing switch is in proper condition. It is also claimed to be much smaller and lighter than the controllers now in use, thus cutting down the dead weight on electric cars which is so damaging to the present road-beds. Its working parts all operating in a medium of high resistance renders it safe from arcs, burns, and cutting by dust. Its inventor, Mr E. F. Edgecumbe, of Lynn, Mass., was in charge of the assembly and testing of the E and K controllers, made by the General Electric Company, from their beginning until last July, and claims that this new controller will more than meet the work required of it.

Electric Clocks.

We illustrate a very useful improvement in self-winding clocks, the invention of Mr. Adam Lungen, of the firm of Edwards & Co., of New York. Being a practical clock maker, he has overcome the difficulties and objections formerly found in self-winding clocks.

The following are the cuts of but two of the many improvements which they manufacture for different requirements: No. 1 is a primary self-winding movement, being wound up every 15 minutes by a single instantaneous contact, the power required being furnished from only three cells of carbon cylinder battery.

By the special construction of the magnets the draught is equalized, a uniform tension is applied to the train by a simple spiral spring, the strength of which can be regulated; the contacts being made and broken

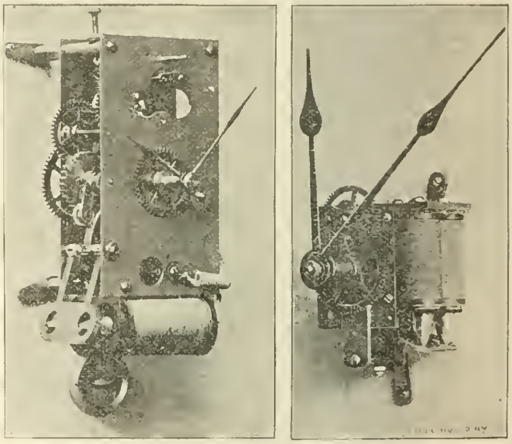


FIG. 1 AND 2.—ELECTRIC CLOCKS.

rapidly, and then only once in 15 minutes, the battery will last an indefinite length of time.

Each movement is arranged to prevent all sparking at the platinum contact points, and is made with either long or short pendulum, and is simple, strong and mechanical in construction.

No. 2 is a secondary movement or minute jumper, constructed on similar principles to the No. 1 or primary clock.

The armature has a long draught, and moves the hands while being attracted, not being jerked forward, but with a regular motion.

It is locked at every movement, so that its uniform acting cannot be interfered with.

As many secondary movements as may be required can be operated from one primary clock.

Mileage of Electric Railways in Europe.

A German engineer has recently investigated all the important electric tramways in Germany, France, Italy, and Swizerland, and the following extract gives the mileage in different European countries at the close of 1893:

	In operation.	In construction.	Total.
Belgium	3.2	18.5	21.7
Germany	102.0	66.1	168.1
England	71.4	21.4	92.8
France	41.4	29.0	70.4
Italy	13.0	—	13.0
Holland	4.9	—	4.9
Austria-Hungaria	33.4	—	33.4
Roumania	—	5.5	5.5
Russia	3.0	7.0	10.0
Sweden and Norway	—	6.5	6.5
Switzerland	23.6	1.6	34.2
Servia	—	10.0	10.0
Spain	14.0	—	14.0
Total	309.9	174.6	484.5

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Dec. 1, 1894.

THE ELECTRICAL STOCK MARKET finds itself in that state of comparative inactivity generally marking the course of stocks toward the end of the month. The indisposition to trade is aggravated by the Thansgiving holiday followed as it is by but a day and a half of actual trading and the Stock Exchange district is pervaded this week by an air of gloom. Quotations accordingly tend downwards though in most instances more in sympathy with the current gloom than in accordance with special reasons.

GENERAL ELECTRIC'S reactionary tendency illustrates the trend of the market. All the news and gossip relative to the stock developing this week has been in the stock's favor, yet quotations fail to develop strength, in fact at times marked weakness is demonstrated. It would seem that the bear clique was not in much need of ammunition to further their campaign as prices continue to fluctuate in accordance with their wishes. None the less, they have endeavored to influence the stock's course by circulating stories regarding the company's labor policy. The true state of affairs is that the General Electric Company has changed its labor system, not by cutting wages 10 per cent. as reported, but by increasing the number of hands employed by the piece, a step that is bound to prove a source of economy to the company The financial side of the company's affairs continues as satisfactory as last reported. Receipts are reported as still exceeding expenditures, and the General Electric Company has now nearly $600.000 in cash on hand besides the $250,000 cash deposited to meet the next semi-annual interest payment on its bonded indebtedness. Besides this amount in cash the company has also in its treasury $1.000.000 of its 5 per cent. bonds, which it purchased at an aggregate cost of about $870.000. Excepting one for $2.126 which it has been unable to get in, the company has no notes outstanding; the only other indirect indebtedness it is liable for are two old guarantees agregating $130.279, which guarantees, it is stated, it may never be called upon to make good.

STANDARD UNDERGROUND CABLE stock, one of the Westinghouse group, has dropped to 90 bid by reason of some litigation in which 20,000 shares of the stock are involved. The intrinsic value of the stock is not affected, however; in fact recent developments in the company, as related in a former issue, have tended to make it more worth possessing than ever.

AMERICAN BELL TELEPHONE stock has been a little affected by the issue of the circular offering to shareholders 5 000 new shares at 190, payable Jan. 5, 1895, when certificates will be ready for delivery. According to the official circular, each stockholder of record Nov. 15, 1894, is entitled to take shares of the new stock in proportion of one share for every forty shares then held. The right to subscribe expires at 2 o'clock on Dec. 22, 1894; no interest, however, will be allowed upon sums paid in advance. All stock not subscribed for by shareholders will be sold at auction. According to Boston advices, there is quite a division among large Bell telephone stockholders as to the wisdom of this measure. Quite a party in the company is in favor of issuing bonds rather than selling stock under the act of the Legislature, but the management has determined to give it a fair trial, future policy to be determined by the outcome of the present issue. The business of the company, as reflected by the instrument output record, is beginning to look up. For the month ending November 20 the net output was 3,313 instruments, a gain over last year, when more telephones were returned than put out, of 5,870. Since December 20, 1893, the gross output has been 81,021 instruments; 65 630 have been returned, so that the net output was 15,391, a loss of 1,823 as compared with a similar period of 1893.

ELECTRIC STORAGE stock has had a boom this week, and many New Yorkers, who hold quite a deal of its $12,000.000 capital stock, are very much gratified. The believers in the property are very enthusiastic regarding its future, claiming that the storage battery manufactured under the company's patents will prove as valuable an enterprise as Bell telephones has in the past.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	98	99
" " " Brooklyn	100	109	112
" " " Boston	100	127	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage	—	37	38
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric.	100	2	3
General Electric	100	34½	35
General Electric, pref	100	68	70
Westinghouse Consolidated, com.	50	34	35
" " pref	50	51	52½

BONDS.

Edison Electric Ill., New York	1,000	107¼	107¾
Edison Electric Light of Europe.	190	75	85
General Electric Co. deb. 5's	1,000	90	91

TELEGRAPH AND TELEPHONE.

American Bell Telephone.	100	195	196
American District Telegraph.	100	40	45
American Telegraph & Cable	100	88	91
Central & South American Telegraph.	100	102	105
Commercial Cables	100	125	145
Erie Telephone	100	51½	52
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
New England Telephone	100	67	69
New York & New Jersey Telephone		97	98
Postal Telegraph-Cable.	100	50	55
Western Union Telegraph	100	86½	87

Ex-div.

WESTINGHOUSE ELECTRIC issues continue quiet. The coming dividend on the preferred stock plays no part in the transactions on the stock exchanges where it is traded in; it will be regular and its value has already been discounted. A feature of the Pittsburg market in the early days of the week was the advance of $1 in the bid price for the company's scrip. There is quite an investment demand for this security. The work of removing the plant to the new works is rapidly accomplished; the completion of the transfer is only a matter of a few weeks at the utmost, when the beginning of manufacture under the new and economical processes estabished in the Branton plant will be an assured fact.

ERIE TELEGRAPH AND TELEHPONE stock has not been very lively of late; none the less quotations hold their own. The company made a net gain of 132 subscribers in October, making the total connected October 31 amounting to 15,932.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have further set aside $47,000 to buy in preferred shares, bids being received until next Monday. So far 17 693 shares in all have been purchased and cancelled.

WESTERN UNION TELEGAPH remains heavy. Another large short interest has been developed, but what with the scant [illegible] floating stock, it may find it unable to cover contracts at current prices

THE ELECTRIC TRACTION STOCK does not develop any further speculative tendencies. None the less there is a noteworthy demand from investment sources, the current low money rates combined with the plethora of funds serving to keep this demand healthy and active. The growth of the traction companies and the part they are beginning to play in the financial world are attracting more and more the attention of the investing public Many of these companies are capitalized at from $10 000,000 to $30 000,000, and as when well managed and not over capitalized they have shown a surprising [illegible] to make money at a rate less liable to variation than is the case with most other enterprises, they have proved themselves corporations whose issues are worth the serious attention of investors. Interest in this class of securities is, therefore, growing daily. Philadelphia notes that the market for street railway bonds and stocks is growing fast, brokers finding it more and more difficult to execute orders by reason of the small floating supply of these securities. New Yorkers are also interesting themselves in street railway projects further west, as Pittsburg has a story that easterners are in a syndicate to buy a controlling interest in the Pittsburg & Birmingham Traction Company, whose stock is quoted around 30. It is also thought that New Yorkers are back of the Chicago General Railway, which is to spend almost immediately $10,000,000 in building trolley roads in West Chicago street railroad territory.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	65	68
" " common	15	16
Long Island Traction	13¾	14
Rochester St. Ry	40	41
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	56	58
North Shore Traction.	22	—
New Orleans Traction.	59½	—
Worcester Traction pfd	82	86
" " common.	14½	16
Metropolitan Traction Philadelphia.	106	107
Philadelphia Traction.	101½	102
People's Traction	55	55½

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. m. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	95	97

*With accrued interest.

NEW INCORPORATIONS.

THE VAN WERT TELEPHONE COMPANY, Van Wert, O., capital stock $10,000, has been incorporated.

THE MT. VERNON AND WALHONDING ELECTRIC RAILWAY, Mt. Vernon, O., capital stock $50,000, has been incorporated by F. T. Botgarn and others.

THE RATON GAS & RAILWAY COMPANY, Santa Fe, N. M., has been incorporated by Frederick Mitchell, Jeremiah Leahy, Alva L. Dobbs, Perry H. Smith and Leslie St. John.

THE CONNERSVILLE GAS & ELECTRIC COMPANY, Connersville, Ind., capital stock $150,000, has been incorporated. H. W. Miller, C. F. Mosier and George W. Combs are interested.

THE MERCHANTS' ELECTRIC COMPANY, Marceline, Mo., capital stock $6,000, has been formed to do electric lighting. Geo. W. Early W. A. Cates and W. A. Cannon, Marceline, are the promoters.

THE NOKOMIS ELECTRIC LIGHT & POWER COMPANY, Nokomis, Ill., capital stock $10,000, has been formed to furnish electric light, etc. The promoters are R E. Cornelius, George Bliss and Garrett Carstens.

THE CLARKSBURG AND SUBURBAN STREET RAILWAY COMPANY, Clarksburg, W. Va., has been incorporated by R. S Gardner, J. H Horner and others to build an electric road in the city. It has a 25-year franchise.

THE POTOMAC LIGHT & POWER COMPANY, Georgetown, D. C., capital stock $35,000 has been incorporated by A. H Wilder and V M Watkins, of St. Paul, Minn , and George A King and W. E Harvey, of Washington.

THE STANDARD ELECTRIC COMPANY Philadelphia, Pa capital stock $1,000, has been formed to supply light, heat and power. The organizers are Jos. A Goodfellow, Thos M Carlin and [illegible] S Deakyne Philadelphia, Pa.

THE UNION ELECTRIC COMPANY Hu[illegible]stead Pa has been incorporated with a capital stock of $150 000 by J Gardner Cassatt Thos A Biddle & Company, Robt Mitchell L. B. Huff Thomas Donohue Wm F L[illegible] and John Lloyd

THE LIBERTY TRACTION STREET RAILWAY COMPANY Pittsburg Pa

...pital stock $...,000, has been formed to construct, maintain and operate a street railway. John F. Scott, W. F. Bickel and Augustus Hartje, Pittsburg, are interested.

THE TACOMA TRACTION COMPANY, Tacoma, Wash., capital stock $500,000, has been formed to construct and operate street and other railways, build sidewalks, etc. Stuart Rice, Geo. B. Blanchard and Chas. S. Fogg are the organizers.

THE TRADERS' ANNEX COMPANY, Clarksburg, W. Va., capital stock $1,000,000, has been formed to construct electric plants, street railways, erect and own buildings, etc. The incorporators are T. M. Jackson, D. R. Morgan and W. B. Maxwell.

THE WATERLOO, SENECA FALLS & CAYUGA LAKE RAILWAY COMPANY has been incorporated with a capital stock of $150,000, to build and operate a surface electric road for four miles from Seneca Falls to Orchard Beach, on Cayuga Lake.

THE CARTHAGE, WEBB CITY, JOPLIN AND GALENA ELECTRIC RAILWAY COMPANY, St. Louis, Mo., capital stock $175,000, has been incorporated. John J. Taussig, David R. Powell, St. Louis, Mo., and Chas. C. Carroll, Springfield, Ill., are interested.

THE SEDALIA AND BROWN SPRINGS ELECTRIC RAILWAY COMPANY, Sedalia, Mo., capital stock $80,000, has been formed to build and operate an electric railway. D. C. Metsker, Chas. Carroll, Sedalia, Mo., and W. E. Sterne, Topeka, Kas., are interested.

THE JAMAICA CONSTRUCTION COMPANY, Haddonfield, N.J., capital stock $100,000, has been formed to build, construct and equip electric railways. Edw. Ilsley, Walter C. Smith, Philadelphia, Pa., and John McNeill, Haddonfield, N. J., are the interested parties.

THE SHORE ELECTRIC COMPANY, Red Bank, N. J., capital stock $100,000, has been formed to manufacture and generate electricity for light, heat and power, etc. Fred. W. Ward, East Orange; Harry P. Chandler, Newark, and Percy Ingalls, Verona, N. J., are interested.

THE S-K-C SPECIALTY COMPANY, Pittsfield, Mass., capital stock $12,500, has been incorporated to manufacture and sell machines, apparatus, tools, electrical appliances and novelties. The interested parties are R. de W. Sampson, Wm. Gardner, John F. Kelly and C. C. Chesney.

THE TOLTEC COAL COMPANY, Denver, Col., capital stock $50,000, has been incorporated to buy, sell and work coal lands, and to construct and operate an electric railway in connection with same. Pliny F. Sharp, John McNeill and Paul Lanius, all of Denver, are the incorporators.

THE SUBURBAN LIGHT & WATER COMPANY, Wheeling, W. Va., maximum capital stock $500,000, has been formed to establish and maintain water works and an electric light, heat and power plant. August Ralf, Anton Reymann and Paul O. Reymann, Wheeling, W. Va., are the organizers.

THE CARDINGTON ELECTRIC LIGHT & POWER COMPANY, Cardington, O., capital stock $15,000, has been incorporated to build, own and operate an electric light and power plant, etc. M. J. Carmack, Evan T. Bown, T. J. Carmack, . H. Fishack and H. F. Fishack are the promoters.

THE GOLDFIELD WATER, GAS, ELECTRIC LIGHT AND POWER COMPANY, Denver, Col., capital stock $100,000, has been formed to construct and operate a plant for furnishing water, gas and electric lights to Goldfield. Peter J. Fredrich, Alois Koch and John L. Frazer, all of Denver, are interested.

THE LULING ELECTRIC LIGHT AND POWER COMPANY, Luling, Texas, capital stock $20,000, has been formed to furnish the city of Luling with electric light and power, and to buy and sell electrical supplies. W. R. Johnson, David Gregg, F. R. Starr, Jr., and H. Kleinsmith, all of Luling, are interested parties

THE DYNAMO-ELECTRIC MAINTENANCE COMPANY, Hoboken, N. J., capital stock $500,000, has been formed to make contracts, maintain electric dynamos, motors, wires, fittings and appliances. The organizers are Geo. F. Dinsmore, Robt. S. Ashe, Boston, Mass., and Leon Abbott, Jr., Hoboken, N. J.

NATIONAL ELECTRICAL REMINDER COMPANY, Chicago, Ill., capital stock $250,000, has been incorporated to manufacture, sell and deal in electrical devices, appliances, instruments, etc., buy and sell patent rights. Siegfried Rosenfield, Augustus Rosenfield, and David C. Thomas are interested.

THE MOORE ELECTRICAL COMPANY, New York, capital stock $50,000, has been formed to manufacture and sell electric lamp vibrator regulators, and other electrical contrivances. Jos. Livingston, Leopold Wallach, D. McF. Moore, New York City, and E. J. Wessels, East Orange, N. J., are the organizers.

THE PORTLAND AND YARMOUTH ELECTRIC RAILWAY COMPANY, Portland, Me. capital stock $200,000, has been formed to build and operate an electric tramway between Portland and Yarmouth. Edward S. Perry, John S. Bradley, New Haven, and Jas. O. May, Naugatuck, Conn., are interested parties.

THE NORTH AMERICAN INTERIOR TELEPHONE COMPANY OF BALTIMORE CITY, Baltimore, Md., capital stock $60,000, has been formed to manufacture telephones and telephone appliances, electric switches and other elctrical machinery. The promoters are Fred. W. Schulz, I. Kemp Bartlett, Jr., Seneca P. Broomal, Chas. G. Hughes and Thomas R. Brunner.

THE STOCKTON GAS AND ELECTRIC COMPANY, San Francisco, Cal., capital stock $1,000,000, has been formed to generate electricity and supply same for light, heat and power; also to manufacture gas, operate and deal in water rights, works, etc. August Muenter, Stockton, Cal.; W. B. Kollmyer, Chas. C. Green, San Francisco; Edward Barry, Oakland; F. W. Longee, Robert M. Welch, and Edward R. Taylor, San Francisco, Cal., are the incorporators.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, New York, Dec. 3, 1894.

MR. GEO. P. FLYNN, late manager of the New York office of the Campbell & ...l Company, of Baltimore, Md., has severed his connection with that firm.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has recently opened an Eastern office in the Havemeyer Building, New York, which will be in charge of Mr. C. I. Hills.

J. S. DUVAL, formerly manager of the New York office of the Ball Engine Company, has severed his connection with this company and engaged himself with Mr. F. R. Chinnock, electrical contractor, 143 Liberty street, N. Y., as office manager.

MR. FRANK X. CICOTT, manager of the railway department of the Pettingell-Andrews Company, Boston, sailed for Europe on the Lucania December 1, in connection with the girder rail business of his house and Messrs. Dick, Kerr & Company, Ltd.

THE SERIAL BUILDING LOAN AND SAVINGS INSTITUTION, of New York City, which was at first composed almost exclusively of telegraphers, was the pioneer of the movement in this line in New York City, where it has now attained huge proportions. The officers of this association on November 15 began the publication of a monthly called the "Serial News," for the purpose of keeping its members fully informed as to the developments in building association matters which affect their interests.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago,
December 1, 1894.

THE JENNEY ELECTRIC MOTOR COMPANY, Indianapolis, is now issuing attractive bulletins setting forth all the good points of its apparatus.

THE ELLIOTT-LINCOLN COMPANY, of Cleveland, O., finds orders coming its way all the time. Its new style of motor is deservedly popular.

THE WEBSTER MANUFACTURING COMPANY is now giving especial attention to the "Lewis" gas engine for electrical work, and reports business as quite brisk. This engine has been on the market for some time, and is at present in service in scores of places driving dynamos.

W. B. AUSTIN has been appointed Western selling agent for the Safety Insulated Wire and Cable Company, of New York, and will make his headquarters in the Monadnock. Mr. Austin was for six years with the Western Electric Company, and for two years with the Knapp Electrical Works. He is one of the most popular salesmen in the West.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, of Cincinnati, O., reports from that town business as rapidly mending. One of its new designs of poles has been adopted by the city for its parks and viaducts. It will shortly place on the market many new and highly ornamental types of electric light and street railway poles. It is now ready to furnish information.

THE EVER POPULAR WABASH RAILROAD, inaugurated on November 1 a system of through tourist sleepers from Chicago to San Francisco, via St. Louis and the Iron Mountain, Texas & Pacific and Southern Pacific Railroads, to leave Chicago daily on the fast express at 10.50 a. m. Full particulars can be obtained at 201 Clark street.

THE GREAT WESTERN MANUFACTURING COMPANY has practically closed out, having sold all its Chicago assets to the First National Bank. There is no chance of resuming. While the condition of this company for some time has been precarious, the collapse was a surprise, as they have been announcing to all their creditors for the past several days that they would at an early date have the necessary means to settle all outstanding obligations, and are now claiming that it was because of Boston people failing to send them promised funds on their recent bond issue, that they are unable to keep this agreement. It is said that the creditors will not be able to realize one cent on the dollar.

Canadian Notes.

Ottawa, Dec. 1, 1894.

AYLMER, QUEBEC.—R. Anderson has installed over 2,000 incandescent lights in this little town.

TORONTO.—A report is current that H. A. Everett, of Cleveland, has resigned the vice-presidency of the Toronto Street Railway Company.

VANCOUVER, B. C.—The electric street railway and lighting system of Vancouver., B. C., has been sold to an English company for $350,000.

MIDLAND ONT.—Application has been made to the Ontario government for a charter by the Midland Electric Light & Power Company. Capital $10,000.

HAMILTON, ONT.—The Hamilton Radial Railway Company asks the city for a bonus of $400,000, in return for which paid up stock to an equal amount is offered.

MONTREAL.—A prospectus has been issued in the London (England) market, inviting subscriptions for £120,000 worth of 4½ per cent. debentures of the Royal Electric Company, of Montreal.

MONTREAL.—The earnings of the Montreal Street Railway Company for October amounted to $88,023 for the month, the average per day being $2,839. The increase for the month, as compared with last October, was $15,580.

TORONTO.—The Magnanetawan Tanning and Electric Company, with a capital of $50,000, has received a charter from the Ontario government, among other things for the purpose of supplying electricity for lighting and heating purposes.

MONTREAL.—At a meeting of the shareholders of the Royal Electric Light Company, the new issue of $750,000 debentures was approved. These are the bonds which D. Morrice was instrumental in floating during his recent trip to England.

TORONTO.—An application has been made by the Toronto & Suburban Railway for a franchise for the extension of its system westward to Lambton and Islington along Dundas street. If the application is successful work will be started immediately.

OSHAWA, ONT.—The agreement for the construction of an electric street railway has been again submitted to the City Council, and on a vote of 8 to 7 was revived. W. E. Rathbun, of Deseronto, deposited bonds for the completion of the road by the time specified.

ONTARIO.—Two electric railway schemes are now under consideration in Northern Ontario. One for running a line from Owen Sound to Kincardine

and the other from Pairy Sound to Ahmic Harbor, both lines to obtain their power from neighboring waterfalls.

VANCOUVER, B. C.—Rumors that the property of the Vancouver (B. C.) Street Railway & Electric Lighting Company have been sold to an English syndicate are confirmed. All employees have received notice of dismissal, as the new company intends to completely reorganize the staff.

HULL, QUEBEC.—Mr. G. Viau, chief promoter of the new electric railway scheme in Hull, stated on Thursday that his company had not been dickering with the Aylmer Road Company. He thought that at the next meeting of the shareholders a proposition might be laid before them to either sell out to the new electric company or grant right-of-way.

OTTAWA, ONT.—A joint stock company has been formed with a capital of $45,000, for the manufacture in this city of primary electric batteries under the patent of C. J. Hubbell, of Washington, D. C. The new carbon and porcelain factory to be built in this city is to be in operation on the 1st of May. It will employ 100 hands. A Peterboro man has been engaged to take charge of the factory.

OTTAWA, ONT.—From Ottawa to Aylmer by electric cars by way of Hintonburg, Shad's Mills and Britannia, crossing the Ottawa River at Deschene Rapids on a bridge that is to cost $150,000, is the move the Canadian Pacific Railway and the Ottawa Electric Railway have combined in. H. B. Spencer, assistant superintendent of the Canadian Pacific Railway, and Mr. Ahearn, manager of the Ottawa Electric Railway, admitted that the scheme was under contemplation and would be begun soon.

HAMILTON, ONT.—One of the most extensive electric railway schemes yet contemplated in Canada is the Hamilton Radial Electric Railway. The intention is to build a network of railroads, steam and electric, radiating from Hamilton and connecting with the more important cities and towns of Western Ontario. It is intended to build a first class road and connect at Woodstock, Toronto and other points with the Canadian Pacific Railway. The electric part of the system will likely be the lines to Berlin and Guelph, and on these the road bed and gradients will be fully up to the first class steam railway requirements. The Niagara Falls branch will be continued to Buffalo.

ST. HYACINTHE, QUEBEC.—The St. Hyacinthe Gas Company, who claimed the sole right to light this city for twelve years, has lost its suit against the St. Hyacinthe Hydraulic Power Company, which is arranging to supply the city with electric light. The latter company has made very extensive improvements in order to increase the power, having made above the dam a canal 600 feet long and 45 feet wide, and below the dam 1,280 feet long by 80 feet in width, all through solid rock, the fall being 17 feet 10 inches. This will probably give them 1,100-hp to dispose of. It will, however, only require about 250-hp to keep the city supplied with light. They have 2,000 lamps placed in the city, and the charge is not to exceed $3 a lamp.

OTTAWA.—The Electric Street Railway Company has decided to issue $187,000 new stock. The present paid-up capital of the company is $625,000. The new stock will make the paid up capital $813,300. The additional money is needed partly to clean off floating liabilities, partly to defray the cost of probable extensions of the system. The present stock has been changing hands, at $165 to $180 per share of $100. From June, 1891, to June, 1892, the first year of operation, the company carried 220,000 passengers and paid 7 per cent. dividend. From 1892-93 the company carried 2,394,000 passengers and paid 8 per cent. For 1893-94 the company carried 2,700,000 passengers and paid 8 per cent. For the present year so far the number of fares has greatly increased.

News of the Week.

TELEGRAPH AND TELEPHONE.

WAYNESVILLE, N. C.—J. E. Hellema contemplates constructing a telephone system.

SUMPTER, S. C.—The Mason Telephone Company will enlarge its plant and put in additional machinery.

ATLANTA, GA.—The Athens Telephone Exchange, H. C. Conway, manager, is to construct a line from Atlanta to Athens.

COUNCIL BLUFFS, IA.—The Nebraska Telephone Exchange is putting in new wires and otherwise improving its service.

MANISTEE, MICH.—A long distance telephone line is to be constructed and the poles are being placed between Manistee and Ludington.

AUSTIN, TEX.—The National Telephone Company and the Anthony Telephone Company have been granted franchises by the city council.

BOSTON, MASS.—Commissioner of Corporations Endicott has decided that the new issue of Bell Telephone stock, 5,000 shares, may be sold at $190 per share.

SPRINGFIELD, MASS.—The New England Telephone Company is negotiating with the West River Company for the purchase of its plant from Townshend to Stratton.

AUSTIN, TEX.—The National Telephone Construction Company is applying to the City Council for a telephone system. J. M. Lindsay, C. R. Smith and others are interested.

DUNKIRK, N. Y.—The proposition which the Phoenix Telephone Company makes to Dunkirk is that if the people there will subscribe to $4,000 stock, the Phoenix Company will erect the plant, which will cost about $11,000.

NEW YORK.—A new telephone company has been organized with the following incorporators: Chas. Oliver, H. B. Rollison, Wm. Howard, Wm. Chamberlain, Ferdinand Thompson and W. J. Lansley. The object of the company is to supply local telephone service to Rahway, N.J., at low rates.

ST. LOUIS, MO.—A new telephone company is to be incorporated under the laws of Missouri with a capital of $1,000,000, and will give, it is claimed, cheaper telephone service than the Bell company. The patent is owned by the Chicago Interior Telephone Company, which is now applying for a franchise to put in its wires in Chicago. The cost, it is said, will be $2 per month, and the telephone will be operated by dropping a nickel in the slot.

ELECTRIC LIGHT AND POWER.

WOODBINE, N. J.—An electric light plant is soon to be established.

BREMEN, IND.—An electric light plant costing $48,000 is to be established at Bremen.

ROCKVILLE CENTER, N. Y.—The question of lighting the streets is being agitated.

LEWISTOWN, ME.—The plans for the municipal electric plant have been settled on.

APPALACHICOLA, FLA.—Address the Mayor concerning contemplated electric light plant.

GADSDEN, ALA.—The Queen City Electric Light Company will double the capacity of its plant.

CAPE MAY, N. J.—A committee was authorized by the Council to inquire into the cost of an electric light plant.

MALVERN, ARK.—The contract for lighting the city has been let and the plant is to be completed by January 1.

TIFFIN, O.—The Tiffin Electric Light Company is making arrangements to largely increase the capacity of its plant.

ESSEX, CONN.—A number of men in Essex are agitating the scheme of organizing a company to light the place by electricity.

HACKENSACK, N. J.—The Edison Electric Light Company's plant which was recently burned, is to be rebuilt at a cost of $30,000.

EDWARDSDALE, PA.—An election will be held February next to decide the question of lighting the streets of the borough of Edwardsville.

WHEATON, ILL.—The Wheaton Electric Light & Water Company, Wheaton, certified to an increase in capital stock from $15,000 to $22,000.

NEWTOWN, N. Y.—The Town Board proposes to lay out a lighting district which will include Grand street, and then advertise for bids.

SAFE HARBOR, PA.—The change at the Safe Harbor Iron Works to convert the old building into a match factory will include an electric plant.

BROWNSVILLE, TEX.—John R. Bood, Jas. A. Brewer and John Clinton have been granted a franchise for the erection and operation of an electric light plant.

RALEIGH, N. C.—The Raleigh Electric Company, which has been organized with A. A. Thompson as president, will put in a complete plant for incandescent lighting.

SYRACUSE, N. Y.—A petition will be presented to the Common Council by the Citizens' Electric Company, which is asking for an electrical franchise for this city.

CLEVELAND, O.—The Ohio and Pennsylvania Coal Mining Company has contracted to equip its Cedar Hill mines with electric mining machinery, at a cost of $35,000.

ST. JAMES, MINN.—The contract was let by the City Council for an electric light plant to the Fort Wayne Electric Corporation, of Fort Wayne, Ind., for the sum of $5,842.

WEEDSPORT, N. Y.—The Board of Trustees of Weedsport has granted a franchise to an electric light company, which agrees to furnish 35 arc lights for $1,500 per year.

MILWAUKEE, WIS.—The Council Committee on Electric Lighting decided to recommend that the city get authority from the State Legislature this winter to make and sell electric light.

READING, PA.—The special committee appointed some time ago to report upon the advisability of the city building its own electric light plant will urge the city to erect its own plant.

LEADVILLE, COL.—The Leadville (Col.) Water & Power Company is to build a pipe line 12 miles in length, and will erect a plant for the purpose of generating electricity to furnish power to the mines and smelters.

LYNCHBURG, VA.—The Lynchburg Electric Company has been awarded the contract for lighting that city with electricity for five years, and is also granted a franchise for poles and wires in the city streets for 30 years.

EDGEWATER, S. I., N. Y.—Application has been made by Cornelius G. Kolff, on behalf of the Midland Railway, for permission to change its motive power from horses to electricity, and to extend its lines to Richmond.

RALEIGH, N. C.—The Raleigh Electric Company's stockholders have authorized an issue of $25,000 of first mortgage bonds for the installation of its electric light plant, and to improve and enlarge its railway equipment.

PORTSMOUTH, N. H.—The Board of Aldermen is considering the purchase of an electric light plant of its own for $60,000, that can be maintained for $8,000 per annum and keep forty more arc lights going than at present.

BRIDGEPORT, CONN.—McMahon & Wren propose furnishing Pleasure Beach with a new and more powerful electric lighting plant, and are considering the wisdom of using the extra power for the operation of a trolley system.

ASBURY PARK, N. J.—The Neptune Eectric Company is in the hands of Judge Joseph H. Gaskill as receiver. The liabilities are $67,000; of the capital stock of $200,000, $54,000 had been paid in. Most of the loss will fall upon residents of Asbury Park.

MONTPELIER, IND.—A company known as the Montpelier Electric Light Company has been incorporated, and a lighting system will be introduced at that place. The capital stock of the company is $15,000. John P. McGeath, of Hartford City, and others, are interested.

SPRINGVILLE, N. Y.—The Western Electric Company, of Thames and Greenwich streets, New York City, was the lowest bidder for putting in the electric lighting plant at Springville, the bid being $9,580.80, and received the contract. The work is to be completed in six months.

ASHLAND, WIS.—The Citizens' Electric Light & Power Company, of Ashland, which has just been organized, will have its new plant in operation by Jan. 1. It has ample capital behind it, the stockholders and directors, include some of the best known and wealthiest men of the city.

BRANFORD CONN.—The Brantoro Water, Light & Power Company has formally organized and elected the following officers. President, B. W. Allderige; secretary, E. F. Bennett; treasurer, F. W. Giddings. It is the purpose of the company to supply the town with water and electric lights.

SEATTLE, WASH.—The contract for lighting Seattle has been awarded to the Rainer Power & Railway Company & the Seattle Gas & Electric Light Company. The city is to be lighted by these new companies after Dec. 1, when the contract with the Union Electric Company expires.

ELIZABETHTOWN, PA.—A charter was granted some time ago to the Elizabethtown Electric Light Company, and the borough has lately given the company the contract to light its streets. The company has begun work on the erection of buildings. Mr. Alfred R. Houch, of this city, has been elected treasurer.

BLOOMFIELD, N. J.—At a meeting of the Bloomfield Township Committee, a long discussion took place over a suggestion by the Gas Committee that they be authorized to advertise for bids for electric lighting by arc lights of 2,000-cp. in view of the termination of the gas lighting contract. The matter was finally laid over until the next meeting.

ROME, N. Y.—The time for receiving bids for the construction of a boiler house and dynamo room at the Rome State Custodial Asylum has expired. No bids were received. The Trustees have found that the specifications lacked some details, and contractors were informed that bids would be readvertised for when these details were arranged.

OGDENSBURG, N. Y.—The Common Council held a special meeting at which the Mayor offered a resolution requesting the Committee on Fires and Lights to confer with the officers of the Ogdensburg Gas Company, and see if some arrangement can be entered into whereby the streets of that city may be lighted by electricity. A franchise was granted to the new electric street railway.

APPLETON, WIS.—A company has been formed by local capitalists to establish a competing electric light and power company, and bid for a share of the business now controlled by the Edison Company. Contracts have been let for a power-house, poles and wires, etc., and the company expects to furnish light by January 1. The plant will be constructed on a basis of 1,000 lights, and will cost about $40,000.

PITTSBURG, PA.—Next month a charter will be applied for by the Suburban Light, Heat and Power Company, which proposes to supply Mt. Oliver, Knoxville and other hill boroughs with electric energy. Those principally interested are Register S. P. Conner, Attorneys T. A. Noble, E. F. Hayes and James W. Patterson and others. A new power house will be built. The Suburban Electric Railway Company will have a controlling interest.

SYRACUSE, N. Y.—In amended form the Citizens' Electric Company's proposed franchise was submitted to the Council, and without action was referred to the Corporation Council and the Committee of the Whole. The amendments are as follows: The corporation shall proceed without delay to erect a plant of 10,000-light capacity, and increase the same from time to time as business may require. In case of default the franchise may be declared void.

PITTSBURG, PA.—Mr. W. R. Thompson, for several years in charge of the electrical plant of Joseph Horne & Co., in this city, has recently been appointed to take charge of the electric plant now being erected in the Carnegie building. This building is fourteen stories high, and is the largest in Western Pennsylvania. The electric plant, consisting of about 3,000 incandescent lights, is the most important isolated plant in this part of the country. All the apparatus is of Westinghouse manufacture.

CONEWAGO, PA.—The Conewago Water & Power Company has made a propositon to operate the water power of the Susquehanna River at or near Falmouth, at or near Chickies, at or near Wrightsville and below Wrightsville and at such points as may be deemed advisable by the company. The aggregate water power is about 10,000 horse power, which will be utilized for the purpose of generating electricity and transmitting it over the wires of the company to distances within a radius of 35 miles.

THE ELECTRIC RAILWAY.

McKEESPORT, PA.—The contract for an electric road between McKeesport and Glenwood has been let.

NEW ORLEANS, LA.—The New Orleans Traction Company will build an electric power plant.

LANCASTER, PA.—There is considerable talk of an electric railway from Lancaster to Elizabethtown.

POTTSVILLE, PA.—The Schuylkill Electric Railway Company will erect a $100,000 power-house at Pottsville.

CATESVILLE, PA.—A trolley line passing through the main street from one end of the borough to the other, is being discussed.

APPLETON, WIS.—The Appleton Edison Company will build and operate an interurban electric road from Kaukauna to Neenah.

CHICAGO, ILL.—The North Side Electric Street Railway Company has increased its capital stock from $500,000 to $1,500,000.

PINE BUSH, N. Y.—An effort will be made by some business men to have the electric road extended from Walden to this place.

SPRINGFIELD, O.—Manager S. L. Nelson reports a proposed expenditure of $75,000 in improvement and extension of street railway lines.

LOCKHAVEN, PA.—Residents of Nippenose Valley held a meeting to discuss the possibilities of an electric road between Lock Haven and Milton.

WILKESBARRE, PA.—The Wilkesbarre & East Side Railway Company has been granted an extension of eight months time for the construction of its rail way.

PEEKSKILL, N. Y.—The Trustees of Peekskill on Tuesday night granted a franchise to the Beach Railway Company to build a trolley road through the village.

OGONTZ, PA.—The power station for the Jenkintown Road will be located at Ogontz. It will have a capacity of 2,500-h. p. and space for additional engines and machinery.

WATKINS, N. Y.—The matter of constructing an electric railway between Watkins and Hanana is being seriously agitated. The road will be about three miles long.

CEDARTOWN, GA.—A franchise has been granted to Charles and J. W. Adamson, E. M. Wistar, J. A. Peck and others to build a street railway, using electric or other power.

NIAGARA FALLS, ONT.—The Town Council has decided to have nothing to do with the Toronto syndicate which proposes to build an electric line from Niagara, Ont., to Chippewa.

TRENTON, N. J.—The Trenton Common Council has passed a resolution to revoke the franchise of the Trenton Passenger Railroad Company. The company failed to provide for transfers.

CHICAGO, ILL. The Chicago Street Railroad Company is building a power-house at Hawthorne avenue and Hobble street. It is to cost $350,000, and Victor Falkenau & Bro. are the contractors.

BATAVIA, N. Y.—An application has been made to the Board of Trustees by A. B. Wilbus, in behalf of himself and the Batavia Street Railway Company, to construct and operate street railways.

WASHINGTON, D. C.—The Washington, Arlington & Falls Church Electric Company is securing right of way for its proposed line which is to extend between the points indicated in its title.

CAMBRIDGE, MASS.—Authority was given the West End Street Railway Company by the Cambridge Aldermen, at a meeting last week, to establish an electric system on Broadway in that city.

PITTSBURG, PA.—The Allegheny Traction Company's barns, on Spring Garden avenue, were destroyed by fire; also several cars and seven new electric motors. Loss, $75,000; insurance not known.

BUFFALO, N. Y.—A dispatch from Albany announces that the Crosstown Street Railroad Company, of Buffalo, has filed with the Secretary of State a certificate of the proposed extension of its route.

KINGWOOD, W. VA.—An effort is being made in Kingwood to raise money for the purpose of building an electric railway between that place and Morgantown and to continue the road to Uniontown, Pa.

NEWINGTON, CONN.—It is now practically decided that the road to be built by the Central Electric Company through this place, connecting New Britain and Hartford, will be completed next summer.

GREEN BAY, WIS.—Green Bay capitalists are considering the feasibility of an electric railroad between that city and Depere. Some of the merchants oppose the project on the ground that it will take away their trade.

GREENVILLE, N. Y.—The Common Council will consider the petition for a franchise presented by the Jersey City, Hoboken & Rutherford Electric Railway Company to operate a trolley system along the Paterson plank road.

FALL RIVER, MASS.—The articles of incorporation for a new electric road, of which the directors are Wendell E. Turner, Arnold B. Sanford, Albert S. Dow, and Mr. Shove is treasurer, will operate about three miles of track.

PUYALLUP, WASH.—An ordinance has been introduced into the City Council looking toward the granting of the right to construct, maintain and operate a street railway, to be completed by January 1, 1896, by W. H. Coler & Co.

APPLETON, WIS.—The Appleton-Edison Electric Light Company is said to have decided to build and operate an interurban railroad from Appleton to Kaukauna. The company's officers believe that the Tilotson project is practically dead.

CHESTER, PA.—The directors of the Nedia, Middletown, Aston & Chester Electric Railway Company will shortly hold a meeting, and it is stated on good authority that the new road will be built and in operation before many months.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Company has practically decided to extend its line down the Walkill Valley to Montgomery, with the expectation of going to Walden later on. Montgomery is only twelve miles from Middletown.

ALLENTOWN, PA.—A party of New York and Philadelphia capitalists are trying to obtain franchises for the construction of an electric road from Allentown to Reading and the Town Council of Emanus has been asked for permission to occupy the streets.

ELYRIA, O.—A company has been formed here to construct an electric railway between this city and Oberlin. The capital stock is to be $100,000, and the road will be built next spring. The projectors are Hon. William A. Braman, C. A. Metcalf, Parks Foster and others.

LIMA, O.—Lima will have another street railway before long. The Lima College people, with some prominent citizen stockholders, have decided to build their own line which will run to the college and around the city; they were granted permission and will start at once.

MILTON, N. Y.—The Boston Electrical Construction Company, to whom the franchise for the construction of an electric railroad from Milton to Ballston Spa was granted, will begin work at once, so that the road will be running by August 1, 1895. The cost will be about $150,000.

FALL RIVER, MASS.—At a special meeting of the Board of Aldermen, November 29, on a petition of the Fall River & Taunton Street Railway Company for a franchise to operate an electric road on specified streets of this city, a hearing was granted to be held Friday, December 14.

HAMILTON, ONT.—The Hamilton Radial Railway Company has evolved a scheme to build a network of railroads, steam and electric, radiating from Hamilton and connecting with the more important cities and towns of Western Ontario, the main object being to divert trade to Hamilton.

LYKENS, PA.—The Council of Lykens has granted the new electric railway company, which will operate a line between Reiner City and Lykens, the right to occupy the streets of that town with its tracks. At Tower City the Williams Valley Railroad Company is opposing the granting of any privileges to its electric rival. The new line will probably be extended to Millersburg.

WALDEN, N. Y.—The company which proposes to build an electric railroad from Orange Lake to Walden has secured the consent of more than half the property along the proposed line, in the village of Walden as well as in the country. It is probable that part of the work of construction will be done this winter.

MARLBORO, MASS.—The Marlboro and Westboro Street Railway Company asked of the Aldermen for a franchise to lay tracks through Northboro and Main streets, from the town line to the soldier's monument. Lewis E. Wilkins,

engineer, represents the company, of which Dr. E. B. Harvey, of Westboro, is President. The road is to be six miles long.

GETTYSBURG, PA.—For the purpose of extending the Gettysburg Electric road to the Maryland line, Hon. Eph. Myers and Mr. John A. Shorb, of Littletown, were at Gettysburg endeavoring to get subscriptions for stocks and bonds. It is proposed to sell $50,000 of the $200,000 in bonds now existing on the road, so as to raise the cash necessary for building purposes.

BIRMINGHAM, ALA.—The Highland avenue & Belt Railway has been sold by Mr. H. M. Caldwell to the Columbus Equipment Company, of New York City. The purchaser will equip the road electrically, and has also secured an option on the East Birmingham Dummy Line, which, in the event of a sale being effected, would be converted to electric power.

GREENBUSH (P. O. ALBANY), N. Y.—A meeting of capitalists and representative citizens was held in Greenbush Friday evening, to discuss the proposed Albany & Suburban Railway Company. It is stated that steps will be taken soon to incorporate the company. It is probable that the trolley system will be abandoned and that the underground conduit will be used.

ISLIP, N. Y.—A syndicate composed of prominent New York and Brooklyn men who are interested in the Austral Hotel Company and Electrical Construction Company, are endeavoring to secure a franchise from the Islip Town Board for permission to run a trolley line from Brentwood, a winter resort among the pines, to the south side of the island, and thence to Babylon.

WARREN, O.—A. A. Anderson and John McVey, of Youngstown, made application to the Commissioners of this county for a franchise providing for the construction of an electric railway from Youngstown to Niles, ten miles. They agree, if a franchise is given them, to have it in operation within a year. Cleveland, Warren and Niles capitalists are also interested in the project.

POTTSVILLE, PA.—At a special meeting of Mt. Carbon Borough Council, the question of granting right-of-way to an electric railway through the streets of the borough was taken up, when, on motion of Patrick Malone, seconded by Patrick Graney, the Pottsville & Reading Traction Company was granted a trolley franchise. This will be a branch of the Schuylkill Electric Railway.

WEYMOUTH, MASS.—The Quincy & Boston Electric Railway has petitioned the Weymouth Selectmen for a location from Commercial Square East Weymouth, to Columbian Square, South Weymouth, through Pleasant street. The building of this extension will give continuous electric service from Boston to Brockton, through Quincy, Weymouth, Rockland, Abington and Whitman.

THE NEWTOWN RAILWAY COMPANY has obtained a franchise to operate an electric system in the town of Newtown, from the point bordering on Long Island City to the Flushing line. The company already has a franchise to operate in Long Island City to the Flushing line, so that an electric road from the latter place to Thirty-fourth Street Ferry now seems to be an assured fact.

WATERLOO, N. Y.—The Waterloo, Seneca Falls and Cayuga Lake Railway Company which is to build and operate a surface road four miles from the village of Seneca Falls to Orchard Beach, on the shore of the Cayuga Lake, has been incorporated. Capital $150,000. Directors, Thos. Craig, of Trenton, N. J.; Chas. E. W. Smith, of New York; Chas. L. Hoskins, of Seneca Falls, and others.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrow's Point Railway Company has about finished its electric road to Back River bridge, a distance of about four miles, and will build branch lines to Ivy Point and Fairy Grove. The company may later on extend its road to Middle Station, on the Philadelphia, Wilmington & Baltimore Railroad. Charles B. McClenn is the company's engineer.

MAPLEWOOD, N. J.—A meeting for the purpose of discussing the advisability of having a trolley road through Maplewood, was held at the residence of Edward L. Crowell. Mr. Crowell was chairman of the meeting, and Alexander Melville was secretary. Those present advocated the construction of a trolley road, and the sentiment as in favor of the Newark and South Orange Street Railway Company.

M'KEES ROCKS, PA.—The proposed scheme of an electric trolley boat system on Chartiers Creek, between McKees Rocks and Carnegie, was the subject of another meeting held at McKees Rocks. Dr. Barr was elected president, and W. H. Sprout secretary. Application for a charter and estimates of the probable cost of the work will be made. It is proposed to widen the creek to 150 feet between the two points.

TERRE HAUTE, IND.—The special election to vote on the subject of appropriating $20,000 to aid in the construction of the Terre Haute and Brazil Electric Railway Company cannot be held on Dec. 17 as was expected. The petitioners failed to file their bond in time to advertise the election four weeks as required by law. The County Commissioners will take up the matter again, and if the bond is satisfactory will fix another date for the election.

CLARKSBURG, W. VA.—The Clarksburg & Suburban Street Railway Company, whose incorporators are R. S. Gardner, Lee H. Vance, Marck McD. Price, C. M. Hart and others, has been granted a franchise for twenty-five years by the Town Council of Clarksburg, to use and occupy certain streets of the city for the construction and operation of an electric street railway. It will be extended to a place on the Milford turnpike opposite the Chautauqua Assembly Ground.

NEW BRIGHTON, S. I., N. Y.—Another enterprise has been developed in the extension and electrical equipment of the lines of the Midland Railroad Company, running from West Brighton to Castleton Corners and from Stapleton to Concord. These lines are principally owned by Nathaniel Niles, of New Jersey, and Otto Ahlmann, president of the Bank of Staten Island. It is said this road has consolidated with the Prohibition Park Electric Railway Company.

COLUMBUS, GA.—The North Highlands Electric Railway Company and the Columbus Street Railway Company have been consolidated. Samuel A. Carter, president of the North Highland line, resigned, and Mr. John Flournoy, president of the Street Railway Company, was elected president of the North Highland line, which will maintain separate organization, but will be controlled by the Columbus Street Railway Company. The lines of both companies will be extended.

LIMA, O.—The proposed new electric street car line will be built without a doubt. The directors are: Col. W. P. Orr, of Piqua; Gen. A. V. Rice, of Columbus; Stewart M. Brice, George H. Meily and Judge J. E. Richie. The line will take in the new Lutheran College, and probably extend to McBeth's and Hover's Lakes, both summer resorts, and it may be extended so as to take in Spencerville and Delphos. The work of surveying the line will be commenced at once.

CLEVELAND, O.—A step toward the extension of the Pearl Street Car Lines across the Brooklyn bridge into the village of South Brooklyn was taken on November 14, when the Cleveland Electric Railway Company bought six acres of land lying between the Columbus pike and the State road. An officer of the railway said that his company expected to have cars running across the bridge early next spring, and that work would be begun toward building a large car-house and perhaps a power-house on the property purchased, as soon as practicable.

NEWARK, N. J.—The Freeholders' Committee on Roads and Assessments met and received two petitions from the North Jersey Street Railway Company for franchises for a surface railway from the village of Irvington, along Springfield avenue, through Clinton township and the townships of South Orange and Millburn, to the Essex County line. The other petition was for a similar franchise for a road beginning at Bloomfield, through the town of Montclair, Verona and Caldwell townships, and Caldwell borough. It was proposed to build double track roads and have them operated with electricity. Both petitions were held over until the next meeting of the committee.

Trade and Industrial Notes.

W. P. THOMPSON & COMPANY, 31 High Holburn, London, England, have reorganized their business and added largely to the technical staff. They have also issued a new edition of their "Chart of Requirements for European Patents."

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., has just received a duplicate order for its machines from Sioux Falls, S. D., and a triplicate order from Dallas, Tex. The company reports November business as very encouraging, and has just placed an order in the foundry for 90,000 pounds of dynamo and motor castings.

M. H. DEVEY, 160 North Fourth street, Philadelphia, has perfected an electrical compound glass cement for use with underground systems to prevent moisture getting to the wires, and for lining pipes of all kinds inside or outside. This glass cement is also suitable for power house floors and roofings. Being a good non-conductor, it is useful for repairs and for stopping leaky roofs of all kinds. It is a strong resistant to water and is particularly adapted for bedding electrical machinery in power houses, etc. It is applied as a paint, or used as a plaster, and is also adapted for general building purposes, as it may be applied to iron, wood, stone or brick.

THE OHIO BRASS COMPANY, Mansfield, Ohio, reports a large number of initial orders for the reversible and adjustable track brush holders, and steel wire track brooms, which have been followed in almost every case by larger ones. In many instances the entire equipment of motor cars have been provided with these. Among the larger roads using them are: The Syracuse Street Railway, Syracuse, N. Y.; The Middletown-Goshen Traction Company, Middletown, N. Y., The Cumberland Electric Railway, Cumberland, Md., The Burlington Electric Railway, Burlington, Iowa, The Steinway Railway Company, Long Island City, N. Y., The Central Electric Railway, Peoria, Ill. The ease with which these holders can be manipulated, and the saving in consequence in the wear on the track brooms, is a strong recommendation in their favor.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., of which Mr. A. G. Davis is president, has established a new factory in the city of Baltimore, pending the reconstruction of its extensive plant at the Relay Station, on the B. & O. R. R., between Baltimore and Washington, which was destroyed by fire in June last. The power waterhouse has already been rebuilt and the other buildings will be completed next spring. In the meantime, orders will be promptly filled from the city works. This company has been making the well-known viaduct magnetic telephone bells without intermission since 1878. So long an experience should have given it an opportunity to perfect the article—and it seems to have done so. Large numbers of district messenger call boxes are also daily turned out by it, one company alone having used 35,000. It is constantly devising new forms and patterns of call boxes and is now filling a large order from St. Louis and Kansas City for the Missouri District Messenger Company.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., has just closed a contract with the Overman Wheel Company, for an electric power transmission plant for its works at Chicopee Falls, Mass., consisting of one 100-kw new type multipolar generator, two 25, one 20 and two 10-hp Manchester motors, with complete switchboard. The Mather Company, which is making a specialty of this class of work, is also installing a similar plant with a 60-kw generator, in the mill of the Connecticut River Paper Company, at Holyoke, Mass. The same company also booked last week the following orders: one 60-kw new type multipolar generator for the Pierpont Manufacturing Company, New Bedford (3rd order); one 550-light dynamo for the receivers of the Union Pacific R. R., Pocatello, Idaho; one 550-light dnyamo for the Rockwell Mfg. Company, Milwaukee, Wis.; one 550-light dynamo for the Hub Gore Makers, Brockton, Mass.; one 100-kw railway generator for the Ithaca Street Railway Company in Ithaca, N. Y.; one 15-kw direct connected dynamo, with Ideal engine, for the Wayne Hotel, Detroit, Mich.; one 350-light dynamo (ring tpye) for the Meriden Britannia Company, Meriden, Conn.; one 350-light dynamo for the Berlin Iron Bridge Company, East Berlin, Conn.; one 150-light dynamo for Burtis & Howard, Minneapolis, Minn.; one 250-light dynamo for C. Dorflinger, White Mills, Pa.; one 150-light dynamo for H. B. Coho & Company, New York City; fifteen Manchester motors from 3 to 15-hp.

Business Notices

Illustrated Record of Electrical Patents.

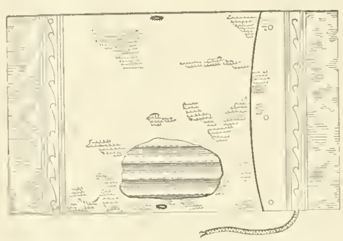
UNITED STATES PATENTS ISSUED NOVEMBER 27, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

529,688. MEANS FOR SUPPORTING MOTORS IN ELECTRIC LOCOMOTIVES; W. S. Adams, Philadelphia, Pa. Application filed November 9, 1893. The combination, in a truck, of side bars, cross bars, longitudinal bars, suspended below the side bars, and means for adjustably suspending the longitudinal bars to the cross bars.

529,704. CLOSED CONDUIT ELECTRIC RAILWAY; C. G. Burke, Brooklyn, N. Y. Application filed February 10, 1894. This comprises a contact arm, two trolleys carried thereby, a supply conductor, a series of normally open branch conductors, means for closing the branches successively, adapted to be operated by one of the trolleys, a return conductor, and circuit connections between the car motor and trolley.

529,710. SECTIONAL THERMO ELECTRIC GENERATOR. H. B. Cox, Hartford,



No. 530,053.—ELECTRIC TOWEL FOR HEATING.

Conn. Application filed January 31, 1894. A generator built up of interchangeable sections, each section exteriorly coated and complete within itself.

529,711. THERMO ELECTRIC GENERATOR; H. B. Cox, Hartford, Conn. Application filed January 31, 1894. A generator having an exterior cooling jacket and an interior liquid body and means for heating the body of liquid.

529,759. ELECTRIC SIGNAL FOR RAILWAY CROSSINGS; D. W. Smith, St. Louis, Mo. Application filed September 10, 1894. This comprises a crossing clamp, a supply conductor, an electric lamp mounted upon and supported by the clamp, and a supply conductor for the lamp.

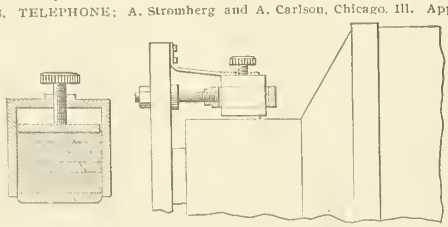
529,784. COMMUTATOR BRUSH FOR DYNAMOS; G. Forbes, London, Eng. Application filed August 8, 1892. A brush consisting of conducting fibrous or textile material.

529,797. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; F. L. King, Chicago, Ill. Application filed January 15, 1894. This comprises a support having journals and a cover removably pivoted to the journals.

529,811. RAILROAD SIGNAL; C. Selden and F. P. J. Patenall, Baltimore, Md. Application filed December 18, 1893. The combination of a main signal, its actuating disk, an overbalancing weight connected with the track lever, a "dwarf" signal, and a power winding ratchet upon the disk for the dwarf signal.

529,812. RAILROAD SIGNAL; C. Selden, Baltimore, Md. Application filed January 4, 1894. The combination of a signal magnet requiring momentary action, a relay, a circuit closer and breaker in the circuit thereof, a circuit controller for the signal magnet, and means for producing a double change of position in the controller on movement of the relay armature in one direction only.

529,818. TELEPHONE; A. Stromberg and A. Carlson, Chicago, Ill. Applica-



No. 529,784.—COMMUTATOR BRUSH FOR DYNAMOS.

tion filed October 9, 1894. This comprises a casing inclosing the coils, a diaphragm support mounted thereon, a permanent magnet, and a casing enclosing the magnet removably secured to the rear of the first named casing.

529,826. TELEPHONE SWITCH; E. S. Combs, Rochester, N. Y. Application filed October 9, 1894. This comprises a plate, arms and lever contacts, a leaf spring, and a link connected at its ends to the spring and the lever.

529,836. CONDUIT ELECTRIC RAILWAY; L. C. Pressley, San Francisco, Cal. Applicatin filed February 6, 1894. This comprises a sectional trolley rail, a conducting wire, and means whereby the sections of trolley rail are charged successively from the wire while the car is passing and cut off afterwards.

529,866. ORNAMENT FOR LIGHTNING RODS; C. F. Keys, Washington, D. C. Application filed March 22, 1894. This comprises a rod and an index formed of two crossed integral arms bent to form the central sockets and terminals in spindle ends, for the reception of letters.

529,894. SIGNALLING APPARATUS FOR TELEPHONE EXCHANGE SYSTEMS; J. H. Cary, Malden, Mass. Application filed March 17, 1894. The combination of a transmitter battery, a local circuit connected therewith, a call bell in the circuit, and a relay controlling the local circuit and connected with the line.

529,895. KEYBOARD ATTACHMENT FOR MUSICAL INSTRUMENTS; J. D. Case, Plainfield, N. J. Application filed March 30, 1893. This comprises a revolving armature and electro-magnet coating therewith, and adapted to operate a sound producing device.

529,903. TROLLEY WIRE SUPPORT AND COUPLING; A. P. Gould, Canton, Ohio. Application filed March 7, 1894. This comprises a body portion having at its lower edge a ledge, a cap having elongated apertures, and binding screws.

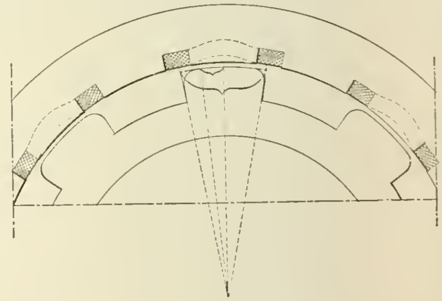
529,918. ALTERNATING CURRENT GENERATOR; J. F. Kelly, Pittsfield, Mass. Application filed August 18, 1894. This comprises a field magnet and armature having opposing faces, one of which bears to the other the relation expressed by the formula of an inverse sinusoidal curve.

529,975. SPEED INDICATOR AND ALARM; G. A. Thompson and J. F. Schmadeke, Brooklyn, N. Y. Application filed April 27, 1894. Two contact rods forming terminals of an electric circuit, a supporting post for the circuit closing rod, a weight carried by the rod, an insulated block in stationary bearings and revolving with the rod, pivoted arms connecting the block and weight, and weight balls carried by the arms.

529,984. ELECTRIC SIGNAL APPARATUS; H. E. Walter, Richfield Springs, N. Y. Application filed January 9, 1893. This comprises a dial, an indicator moving on the dial, an escapement for automatically operating the indicator, a magnet for operating the escapement, and a spring for automatically assisting the movement of the indicator in one direction.

529,986. ELECTRIC SIGNALLING APPARATUS; H. E. Walter, Richfield Springs, N. Y. Application filed April 26, 1894. This comprises signal boxes, connections to a central station, a box selecting device at the central station, a retransmitting apparatus, a circuit operated by the retransmitting apparatus, and indicating apparatus operated by the circuit.

529,992. CONDUCTOR COIL FOR ARMATURES AND FIELD MAGNETS AND METHOD OF MAKING SAME; E. W. Alexander and H. Groswith, Philadelphia, Pa. Application filed September 22, 1893. This consists in winding



No. 529,918.—ALTERNATING CURRENT GENERATOR.

a conductor with a spacing cord and thereafter removing the cord and covering the winding with enamel.

529,999. SWITCHBOARD; L. A. Berthon, Paris, France. Application filed October 17, 1893. This comprises movable spring jacks having springs, in combination with connecting springs making frictional contact with the former springs, and an insulating piece between the springs.

530,004. ELECTRICAL CONTACT MECHANISM; J. F. Blake, New Haven, Conn. Application filed June 21, 1894. This comprises an arm, a rotatable disk, and contacts placed within reach of the disk.

530,020. APPARATUS FOR WELDING RINGS; C. L. Coffin, Detroit, Mich. Application filed March 13, 1894. This comprises a clamp, a movable furnace, a movable anvil, and connecting mechanism for moving the furnace toward the clamp, and moving the anvil in proper relation to the clamped article.

530,021. METHOD OF ELECTRICALLY HEATING METAL; C. L. Coffin, Detroit, Mich. Application filed July 10, 1894. This consists in bringing the metal in circuit with a liquid electrode containing a substance more volatile than water.

530,032. ELECTRIC ELEVATOR MOTOR; W. C. Fletcher, St. Louis, Mo. Application filed June 14, 1894. This comprises an armature wound in independent multiple and a sectional series field to produce a counter electromotive force which will equal that of the normal speed when first starting the motor, and means for constantly maintaining the counter electro-motive force.

530,033. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; Z. Foster, Chicago, Ill. Application filed March 7, 1894. This comprises a line wire and branches, a sectional conductor arranged opposite the terminals of the branches, contact blocks, springs for normally separating the sections and branches, and a trolley mechanism for producing the required engagement.

530,053. ELECTRIC ROBE FOR HEATING; H. G. O'Neill, Boston, Mass. Application filed April 9, 1894. This comprises a resistance and flexible fabric, and a branch conductor for cutting out the resistance.

530,066. PLUG AND RECEPTACLE FOR ELECTRICAL PURPOSES; D. J. Cartwright, Boston, Mass. Application filed January 24, 1894. A plug having a tapered body, electrodes, a socket for the reception of the body of the plug, and electrodes secured to the block.

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CONTENTS.

A PECULIAR PHENOMENON.

While the cause of the phenomenon described by Mr. M. W. Hassan in another column may not have the appearance of an acoustic one, it can scarcely be ascribed to an electro-magnetic source in the sense of having its origin in electromagnetic vibrations of the ether. While electromagnetic waves may be generated of numerically the same length as sound waves, yet the former are in the ether while the latter are disturbances of a material substance, air, which causes sound through a mechanical action on the tympanum of the ear. It is true that etheric vibrations cause the sensations of light and heat, but their action is a molecular not a mechanical one.

ELECTROLYSIS BY ALTERNATING CURRENTS.

The point brought forward by Drs. Bedell and Crehore in another column has a bearing on the question of electrolysis by alternating currents. It is known that in some cases the two carbons of alternating current arcs are consumed at unequal rates, and the explanation offered is that this naturally follows where the form of the current curve is unsymmetrical. The same reason would account for electrolysis under the same circumstances, and such electrolysis has also been noted. Should this explanation be true, and it seems to be entirely reasonable, it follows that unsymmetrical alternating currents are more dangerous than if symmetrical. An application of the principle might be usefully made by designing alternators for electrocution purposes, to generate unsymmetrical currents, thus adding to the effect on the criminal.

FLY-WHEEL ACCIDENTS.

In this issue we present some further contributions to the subject of fly-wheel accidents which has been so exhaustively discussed in our columns—one by Prof. Sharp, of the City and Guilds of London Technical College and the first section of another by Mr. W. Stuart Smith. Prof. Sharp's system of fly-wheel construction is an exceedingly interesting one, and while it seems to present some mechanical difficulties in securing the necessary rigidity, these have doubtless received full consideration from the inventor. We await with interest the promised account of the practical working of the wheel, which, in the interest of engineering science, we trust will be as successful as anticipated by the inventor. Mr. Smith discusses the subject in his usual forcible manner and does not hesitate to take issue with some of the principles which have been generally accepted as well-founded. As the matter under discussion is one of prime importance, we continue the offer of our columns to those who can add to its value.

MULTIPHASED POWER TRANSMISSION.

In another column we print an interesting article from the pen of Mr. Ralph D. Mershon, which develops a branch of multiphased transmission that has before been scarcely touched upon. While the statement by Mr. Mershon is correct that there is a saving of 25 per cent. in copper in favor of the three-phased system over the independent two-phased system, the comparison, it should be borne in mind, is quite different if the common return-wire-two-phased system is considered. It has been shown in our columns that for a given amount of energy transmitted at a given loss and with an equal stress on the insulation, there is, on the basis of effective E. M. F., with three-wires used in each case, an economy in copper in favor of two-phased currents of 3 per cent.; while if equal maximum stresses on the insulation be considered, there is an economy of copper of 94 per cent. in favor of three-phased currents. The first case differs further from the second through the fact that the saving in the

...mer is the same whether effective or maximum E. M. F. is considered. This, however, is a matter aside from the main points dealt with by Mr. Mershon, in regard to which we shall be pleased to hear from those who have had opportunities to study them.

THE STORAGE BATTERY INDUSTRY.

As we look back on the development of the electrical industries during the past fourteen years—a commercial development unparalleled in the history of the world—we find one singular circumstance connected with it, which is that aside from some promotors and inventors, but few have profited from a business that from its vastness should have been an incomparable source of wealth. When we come to examine into the causes we find that perhaps the principal one has been the stupendous litigation, which will render the period almost as memorable from a legal as from an electrical standpoint. No branch of the industry has suffered more in this respect than that relating to storage batteries, in which not only have millions of money been lost but the industry itself throttled for years. Owing to the legal impediments encountered at every step the slight commercial progress made by this branch in comparison with other electrical ones, became a matter of reproach, and even led to the storage battery itself falling into an undeserved repute. It is, therefore, with satisfaction that the new era will be regarded which has been just inaugurated by the consolidation of warring storage battery interests, referred to in another column, and which we trust will result in the fulfilment of the sanguine hopes of those who have so long looked for the storage battery to take its merited place among the electrical industries. While it is much to be regretted that the peace between the hostile interests was not sooner established, the present is yet an opportune moment, for the field of usefulness is now well prepared in many respects. For central and power station work the opening is already a wide one, and it is not at all improbable that the future may see the storage battery an essential part of every station equipment. The same in a somewhat less degree is true of its use with isolated plants, and he would be rash indeed who would maintain that storage battery traction contains no possibilities, notwithstanding its lack of success in the past. Developments in other directions can now also be attempted without the fear of an untimely halt being called. Not the least benefit of the industry being placed on an assured basis is that its success will result in again attracting inventors to the field, and perhaps some of the theoretical considerations recently put forth by German electrochemists may thereby be worked into practical realizations.

THE LIGHT OF THE FUTURE.

Dr. Palaz in his work on photometry remarks that to improve the optical efficiency of light sources "there should only be produced "such vibrations of the ether as are susceptible of affecting the "retina," or vibrations having a wave length between .81μ and .36μ —μ being 0.001 mm. The problem thus is not a complicated one as far as its statement is concerned, and when we learn that the greater part of the energy of the voltaic arc is lost in heat at a wave length of only 1.16 μ we see that the question of producing "cold light" resolves itself into one of reducing this wave length less than 50 per cent. Unfortunately it too often happens that what to Nature is but a minute interval in the course of a phenomenon, is yet the entire extent that the powers of man are permitted to affect. In the present instance there is, however, a growing hope that human endeavor will finally succeed in so directing the motion of the ether that the numerically slight reduction necessary in the wave length of vibratory energy may be obtained. In this connection it is interesting to compare the various sources of light with relation to the proportion of their vibratory energy utilized in producing the sensation of light. As we know the amount of energy contained in a given weight or volume of oil and gas and also the corresponding amount of light produced, it is a simple matter to express the unit of light given by these illuminants in watts. We thus find that an oil flame requires about 42 watts of energy per candle power emitted, and the ordinary gas jet 93 watts; with the incandescent lamp and voltaic arc these figures are 3.1 and 0.8 watts respectively. Accepting the efficiency given by Weber of the incandescent lamp at normal candle power,—one per cent.—the optical efficiencies of the above sources are therefore .07, .03, 1.0 and 4 per cent. respectively, while Dr. Palaz quotes the efficiency of the magnesium lamp at 15 per cent. and that of the Geissler tube at 32.7 per cent. The gas flame, therefore, dissipates 99.3 per cent. of its energy in vibrations that do not produce the sensation of light, and the maximum dissipation occurs at a wave length of 1.6μ, the corresponding maximum of the voltaic arc being 1.16μ. We see from the above that high optical efficiencies are obtained in three ways,—by a high degree of incandescence of carbon and of magnesium and by vibratory motion set up in the ether by an electric discharge through a Geissler tube. With carbon as a material we cannot expect a greater efficiency of the arc lamp than at present, as it has been shown that the temperatures of the crater cannot be increased (unless under pressure) since it now corresponds to the point of vaporization, while the incandescence of the carbon filament has also probably reached a practical limit. The only chance of improvement in this direction, then, seems to lie in the utilization of a material which may be raised to a higher temperature and incandescence than carbon, or, like magnesium, will at a given temperature give off a much larger number of luminous rays than carbon. The experiments of Tesla and Ebert in producing the requisite rate of etheric vibration by electrical instead of thermal means contain the greatest promise, even if the efficiency of the Geissler tube is merely attained in a practical light, and there is hope that it may extend much further than this. Finally, it is not impossible that we may even solve the mystery of the light of the fire-fly, which would be the most perfect solution of the problem; Langley finds that all of the radiations emitted from this source have a wave length between .45 μ and .65 μ and therefore the optical efficiency is probably 100 per cent.

Electric Welding Patents.

The suit brought by the Thomson Electric Welding Company, of Lynn, Mass., against the Two Rivers' Manufacturing Company, of Wisconsin, has been terminated by the entry of a decree sustaining the validity of the fundamental patents of Elihu Thomson on electric welding and apparatus therefor, and adjudging that the defendants have infringed the same.

Several weeks ago a preliminary injunction was granted against the Two Rivers' Manufacturing Company by Judge Seamans, who rendered an opinion sustaining these patents. The case was carefully tried on behalf of the defendant and all known defences were before the court. The judge found, however, that the patents were valid and were not affected by any of these defences, and granted an injunction.

The Two Rivers' Manufacturing Company has settled for the past and taken a license from the Thomson Electric Welding Company on its regular terms.

A Criterion of Dullness.

An English contemporary remarks that when a member of a scientific society advances to the blackboard and says, "Let P be a body of perfect conductivity and of any shape," carefully drawing it and shading it, "immersed in an infinite isotropic dielectric of inductive capacity K, and r and s_1 two infinitely small charges," also carefully drawn, "moving with the velocities v and v_1," then we know things are going to be a little dull.

Electrical Muscle Making.

A Viennese electrical journal quotes a recent note published in The Electrical World (Aug. 11, see also Nov. 24, p 544), and makes the suggestion that hereafter cattle raisers will find that an electrical machine is more important to them than the finest pasturage.

Nature's Method.

The London *Electrician* says that nature, so far from objecting to fractional indices, really protests against jumping from stepping stones of squares to cubes and higher powers, and prefers to wade with dignity through the stream.

Absorption of Storage Battery Patents.

One of the most important electrical deals of recent years was consummated at Philadelphia last week, through which all of the fundamental storage battery patents were acquired by the Electric Storage Battery Company, the owner of the chloride battery patents.

The Faure group of patents (including those of Swan, Sellon, Volckmar and Griscom) were acquired from the Accumulator Company, the Brush-Julien patents from the Consolidated Electric Storage Company and the Brush patents from the General Electric Company. This ends absolutely the extensive litigation in which the various companies had become involved and the Electric Storage Battery Company will henceforth be the sole manufacturer of storage batteries under the patents acquired.

No official statement has as yet been made in regard to the future relations with the companies from whom the various patents were purchased, but it is reported that there will be a friendly coöperation. The Electro Dynamic Company, which has always been closely connected with the Accumulator Company, will continue to manufacture dynamos and appliances for storage battery plants and it is reported that the General Electric Company will exert its influence in favor of the interest now in possession of the patents.

The incorporation papers of the Electric Storage Battery Company were amended on Dec. 6, at Trenton, N. J., so as to increase the capital of the company from $10,000,000 to $13,500,000. It is stated that a proposed issue of stock to the amount of $500,000 has already been underwritten at $50 per share by a syndicate of well-known financiers.

A Peculiar Phenomenon.

BY M. W. HASSAN.

In experimenting with a rectifier supplied with a constant curent supplied from two cells of dry battey, I have often noticed that the magnetism working against the resistance offered by a tension spring, produces a series of harmonics as the spring is gradually tightened and the reverse when loosened. Although the sounds are not as well defined as are musical notes and some of them often very "unmusical," still there seems order enough to detect a substantial scale of sound extraneous and distinct from the mechanical noise or "buzz" of the instrument.

To be more explicit, this rectifier is a combination of two magnets, one fixed, the other vibrating in the same magnetic field producing induction interacting end to end, not concentric; it also acts as a reciprocating motor, while its simplest function is that of an interrupter. A short time since I noticed that it produced quite clearly the musical note of "G," which I could hear quite plainly in a certain position; but when the ear was placed in another position the sound vanished; this struck me as peculiar, for it was a sound effect pure and simple, and should be heard in all positions the same relative distance from the instrument. With a change of but a few inches in any direction from this certain point the note was lost, seeming to drop out of audition without any diminution or gradual drop in intensity. I pondered on the subject some time and wondered if the time had come when the human ear could hear something that was not sound, say one foot away from the place where it certainly was sound, for it must have made itself known through the tympanum, and its apparent volume was such as to warrant hearing it across a room.

It can be accounted for in this way, that it was a very minute sound and that some phase of induction produced a microphone effect which exalted the note so that the ear was treated to a normal rendition.

This quasi-explanation or generalization, however, did not satisfy the writer, and not until your last issue of December 1 was received was there any more light flashed on this dark subject. In that issue, however, there is in the Digest an extract regarding "refraction and dispersion rays of electric force," wherein it is stated that "the rays proceeding from a Hertzian primary conductor may be analyzed into a spectrum by a prism made up of resonators." Although this statement does not definately settle the fact of the existence of such a thing as the "magnetic spectrum," still it affords some comfort to know that interested parties are looking for such a spectrum in the ultimate hope of finding it. The rectifier above referred to is so constructed as to approximate to what might, by a little forcing, be called four resonators or, in reality, four loop paths which terminate in steel springs, platinum faced, which act as contacts but may on approach or retreat accommodate static discharges; in fact, there is sparking between them when in operation.

Thinking that the note might proceed from the tension spring, which is a very short steel spiral, the same was muffled and the note survived, apparently showing it to be a genuine induction effect.

I was familiar with the principle of Elisha Gray's harmonic telegraph and have read much in your valuable paper about harmonics as a destroyer of efficiency in light and motor circuits, but never had an opportunity to see a practical illustration of any such effects except such as here described with a very crude apparatus.

Is it not possible that in a magnetic field, distortion of the lines of force may produce vibrations in the ether which are analogous to air waves and that sound may be conveyed to the auditorium, not through tympanum but by the condenser effect of the human body?

A case in point is that of a metallic point near a static machine "blowing" the flame of a candle, the flame being distorted identically as if a current of air was blown against it; the air is stationary but the stream of ether proceeding from the metallic point completely counterfeits an air effect. The eye cannot detect any difference between an air or ether effect, both acting the same on the optic nerve; following out the same analogy, why cannot the auditory nerve be deceived as to whether its impression comes from the ether or the air?

Consumption of Alternating Arc Carbons.

BY FREDERIC BEDELL AND A. C. CREHORE.

In the early part of 1892 our attention was called to the fact that the two carbons in an alternating arc light are in some cases consumed unequally. The same current and quantity of electricity flow through each and the phenomenon seems scarcely expected. In a paper presented before the American Institute of Electrical Engineers, June 7, 1892 (Transactions, Vol. IX., p. 370; see also Alternating Currents, p. 170), we showed that with an unsymmetrical alternating current, the energy expended during successive semi-periods may not be equal, although in all cases the quantity of electricity which flows is the same. This, we suggested, "may afford an explanation for the fact that in many cases one carbon of an alternating current arc lamp is consumed more rapidly than the other, depending upon the way it is connected up." Exception having been taken to this statement, a fuller explanation of its significence may be in place. In a recent communication to the London *Electrician* (Nov. 9, 1894), we have discussed this question and from this we quote in part.

It is well known that in an arc lamp supplied with the direct current, the consumption of the two carbons is unequal, notwithstanding the fact that the same current and the same quantity of electricity pass through both. The positive carbon is consumed the faster, and for the purpose of illustration we will assume that the positive is consumed twice as rapidly as the negative carbon. This being the case, consider the alternating arc lamp, with carbons A and B supplied with an unsymmetrical alternating current, such that the *energy* in successive semi-periods is not equal, being greater when A is positive. If the frequency is 130 complete periods per second, then one-half of a period lasts 1-260th of a second. During the first 1-260th of a second, when A is positive, we may regard the lamp as a direct current lamp, and suppose that A now loses 6 units of carbon. During the same time B therefore loses one-half as much, or 3 units, as in a direct-current lamp. During the next 1-260th of a second the current reverses and B is now positive. Under the assumption that this semi-period is unsymmetrical with the first, so that the energy is less now than during the first semi-period, of course B will lose less carbon than A did before. Suppose B now loses 4 units. Regarding the lamp as a direct-current lamp during this semi-period, A will lose one-half as much as B, or 2 units. Evidently during the whole period, or during the 1-130th part of a second, A loses $6 + 2 = 8$ units, while B only loses $3 + 4 = 7$ units, and so on during every successive period A loses more than B. It therefore follows that this is a possible explanation of the phenomenon, known as the result of experiment, that in many cases the two carbons in an alternating arc lamp are consumed unequally.

Concentric Wiring.

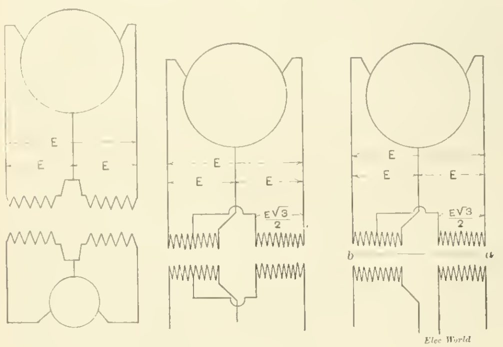
In a letter to the London *Electrical Review*, Messrs. J. D. F. Andrews & Co. state that recent experiments tend to show that whether concentric wire consists of iron or copper, the self-inductance is practically the same, and if an ordinary copper concentric cable is used in place of the iron armor, section for section, the results are the same in every case.

Some Notes on Multiphase Power Transmission.

BY RALPH D. MERSHON.

Until lately, one of the chief claims of the two-phase system of power transmission to superiority over the three-phase has been the fact that with the former transformation of power could be effected with two instead of three transformers. Now, however, there are several well know methods of transforming the power of three-phase circuits by the use of two transformers, though, as will be shown, at some sacrifice as regards the capacity and efficiency of the transforming apparatus.

In what follows it is assumed that the transformers are always worked at the same E. M. F. and current and therefore at the same loss. In obtaining the ratios given below, the losses in the transformers are neglected and the consequent small error is in the direction of making the ratios slightly less than they should be.



FIGS. 1, 2 AND 3.

Fig. 1 shows one method of connecting two transformers for transforming from three-phase to three-phase. If the current in each lead is C, the output of the pair of transformers is, neglecting the losses, $EC\sqrt{3}$. The same two transformers if used on a two-phase circuit at the same E. M. F. and current will have an output of $2\ E\ C$.

$$\therefore \frac{\text{Output 2-phase}}{\text{Output 3-phase}} = \frac{2\ E\ C}{\sqrt{3}\ E\ C} = 1.155$$

or the output of the transformers will be about 16 per cent. greater on a two-phase than on a three-phase circuit. If the three-phase loss is p per cent., the two-phase loss is $\frac{p\sqrt{3}}{2} = .867$ per cent. Hence if the efficiency three-phase 97 per cent. the efficiency two-phase is 97.4 per cent.

Fig. 2 shows another method of connection for three-phase to three-phase transformation. As before, with a current C in each of the three-phase leads, the output is $E\ C\sqrt{3}$. When used on a two-phase circuit at the same E. M. F. and current the output of one converter is $\frac{E\ C\sqrt{3}}{2}$ and of the other $E\ C$. The output of the two is therefore $E\ C\left(\frac{\sqrt{3}+2}{2}\right)$, or the

$$\frac{\text{Output 2-phase}}{\text{Output 3-phase}} = \frac{E\ C\left(\frac{\sqrt{3}+2}{2}\right)}{E\ C\sqrt{3}} = 1.077.$$

That is, the output of these converters on a two-phase circuit is about 8 per cent. greater than on a three-phase circuit. If the loss three-phase is p per cent. the two-phase loss is $\frac{p\ 2\sqrt{3}}{\sqrt{3}+2} = .928$ per cent If the three-phase efficiency is 9 per cent. the two-phase efficiency is 97.2 per cent.

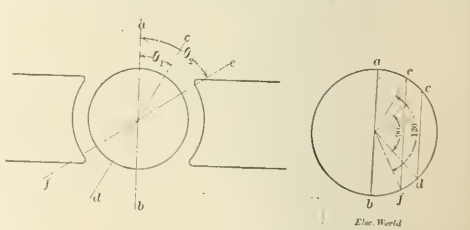
Fig. 3 shows the connections for transforming from three to two-phase with two transformers. It the current in each three-phase lead be C the output of the transformers is $E\ C\sqrt{3}$. The output of the transformer a when used on a two-phase circuit is $\frac{E\ C\sqrt{3}}{2}$. If the transformers have the same total copper loss and are designed as they should be with equal losses in the primary and secondary coils, the primary of a, the secondary of a and the secondary of b, will have equal amounts of copper. Since the primary of b must have $\frac{2}{\sqrt{3}}$ times as many turns as that of a, the wire in b must have $\frac{2}{\sqrt{3}}$ times the section of that of a in order that the copper losses in the two shall be equal. The primary of b has therefore $\frac{2}{\sqrt{3}} \times \frac{2}{\sqrt{3}} = \frac{4}{3}$ as much copper as that of a. If b is to be run on a two-phase circuit, there must for best results be equal amounts of copper in its secondary and primary. Dividing then, this $\frac{1}{3}$ excess of primary copper between primary and secondary, we shall have a converter in which each coil has 7-6 as much copper as the secondary of b originally had. Since the output of a transformer coil at a constant voltage and copper loss varies as the square foot of the amount of copper, and since the output of the secondary of b was originally $\frac{E\ C\sqrt{3}}{2}$ the ouptut of b as thus changed is $\frac{E\ C\sqrt{3}}{2}\sqrt{7/6}$ when ruu on a two-phase circuit. The combined output of the converters on a two-phase circuit is therefore

$$E\ C\frac{\sqrt{3}}{2}\sqrt{7/6} + \frac{E\ C\sqrt{3}}{2} = E\ C\frac{\sqrt{3}\ (1+\sqrt{7/6})}{2}$$

$$\frac{\text{Output 2-phase}}{\text{Output 3-phase — 2-phase}} = \frac{E\ C\sqrt{3}\ (1+\sqrt{7/6})}{E\ C\sqrt{3}\times 2} = 1.042$$

or the two-phase output will be about 4 per cent. greater than that on a three-phase-two-phase circuit. If the three-phase-two-phase loss is p per cent., the two-phase loss is $\frac{p\ 2}{1+\sqrt{7/6}} = .96\ p$ per cent. If the three-phase-two-phase efficiency is 97 per cent., the two-phase efficiency is 97.1 per cent.

The advantage claimed for the three-phase over the two-phase system of transmission is economy of copper, since with the same stress on the line insulation the former requires only ¾ as much copper as the latter for transmitting the same power at the same loss. In ordinary practice, however, the stress on the insulation of the line is of small importance as compared with that on the insulation of the apparatus delivering the power to line, since the difference in cost of installing and maintaining a line for say 5,000 volts and a line for 1,000 volts is small as compared with the difference in cost of the generating or transforming apparatus for the same voltages. Therefore, unless the stress on the line insulation is identical with that on the insulation of the apparatus delivering power to line, the line E. M. F. is not the proper basis for comparing the two systems. When the power is delivered to line from converters or from an open coil armature the stress on the insulation of line and the insulation of apparatus is identical, but when a closed coil armature is used these stresses are not always identical. In a closed coil armature the effective E. M. F. (square root of mean square) to whose maximum the insulation stress in the armature is due, is the same as the effective E. M. F. of a two-phase circuit but greater than that of a three-phase circuit lead off from this armature. If the effective E. M. F. for whose maximum the armature must be insulated is E, the effective E. M. F. of a two-phase



FIGS. 4 AND 4a.

circuit from that armature is E and that of a three-phase circuit is $\frac{E\sqrt{3}}{2}$. If e be any effective voltage and K a constant such that $\frac{K}{e^2}$ is the copper required for the transmission by a two-phase system of a given power at a given loss, $\frac{3}{4}\frac{K}{e^2}$ is the copper required for a three-phase system under the same conditions. Putting in the values $e = E$ and $e = \frac{E\sqrt{3}}{2}$.

$$\text{Copper, Two-phase} = \frac{K}{E^2}$$

$$\text{Copper, Three-phase} = \frac{\tfrac{3}{4}K}{\left(\frac{E\sqrt{3}}{2}\right)^2} = \frac{K}{E^2}$$

That is, for the same stress on the insulation of a closed coil armature feeding the line direct, the same amount of copper will be required for the transmission of the same power at the same loss whether a two-phase or three-phase system be employed.

There is no doubt that a great deal of power transmission will be accomplished by means of a closed coil generator feeding direct to line, thus avoiding converters with their losses and impairment of regulation and taking advantage of the high efficiency and output of a closed coil armature. The point made above therefore becomes of some importance, since it shows that for the same cost of generating apparatus we may have all the advantages of a two-phase system as regards regulation, efficiency and transformation (where it is desired to reduce the voltage at the receiving stations) and yet sacrifice nothing as regards economy of copper.

The relation given above as existing between the two-phase and three-phase E. M. F.'s from the same or similar closed coil armatures may be demonstrated as follows: Let Fig. 4 represent the closed coil armature of a two-pole generator whose coils give a sine wave E. M. F. The lines ab cd and ef bounding the angles θ_1 and θ_2 are supposed stationary. A pair of leads attached at the ends of a diameter will have between them the greatest effective E. M. F. the armature can give; call this effective E. M. F., E. When this diameter coincides with ab, E will have its maximum value, $E\sqrt{2} = e$. Let the number of coils included by the unit angle be n. Then the number of coils in series over an angle $d\,\theta$ is $\frac{n d\,\theta}{2}$. If these coils $\frac{n d\,\theta}{2}$ are at any instant in an angular position θ, the E. M. F. in each coil at that instant is k-sin θ and the total E. M. F. of the series $\frac{n d\,\theta}{2}$ is $\frac{n d\,\theta}{2}\,k \sin\theta$. Therefore the E. M. F. in the series of coils included at any instant between the angles θ_1, and θ_2 is

$$e' = \frac{n\,k}{2}\int_{\theta_1}^{\theta_2}\sin\theta\,d\,\theta = \frac{n\,k}{2}\Big[-\cos\theta\Big]_{\theta_1}^{\theta_2} = \frac{n\,k}{2}\Big[\cos\theta_1 - \cos\theta_2\Big]$$

when $\theta_1 = 0$ and $\theta_2 = \pi$, $e' = e$

$$\therefore\ e' = e = \frac{n\,k}{2}\Big[1 + 1\Big] = n\,k \quad \therefore\ e' = \frac{e}{2}\Big[\cos\theta_1 - \cos\theta_2\Big]. \quad (A.)$$

When $\theta_1 = 30°$ and $\theta_2 = 150°$ we have the condition for maximum E. M. F. of one phase of a three-phase circuit.

$$\therefore\ e' = \frac{e}{2}\Big[\tfrac{1}{2}\sqrt{3} + \tfrac{1}{2}\sqrt{3}\Big] = \frac{e\sqrt{3}}{2}$$

Therefore, the maximum E. M. F. of the two-phase circuit is e, that of the three-phase is $\frac{e\sqrt{3}}{2}$ and the effective voltages, since they bear to each other the same relation as their maxima, are, as stated above, E and $\frac{E\sqrt{3}}{2}$. It follows from equation (A) that if a circle be drawn as in Fig. 5 with a diameter $a\,b = E$, the chord subtending an arc equal to that included between the points of attachment to the armature of any two leads will represent either the maximum or effective electromotive force between those leads accordingly as E represents the greatest instantaneous electromotive force or the greatest effective electromotive force the armature is capable of giving.

Referring to Fig. 5 for an angle π between leads the E. M. F. is $a\,b = E$; for an angle $\frac{\pi}{2}$, $cd = E\frac{\sqrt{2}}{2}$; for an angle $\frac{2\,\pi}{3}$, $e\,f = \frac{E\sqrt{3}}{2}$, etc. Also, if there be n leads symmetrically connected to the armature, the E. M. F. between any two adjacent ones is E sin. $\frac{\pi}{n}$ and this is, as just explained, the maximum or effective E. M. F. according to the significance of E.

It may be mentioned incidentally that equation (A) gives the E. M. F. between any two points on the commutator of a direct current machine, whose coils generate a sine E. M. F. wave when E is the E. M. F. between the main brushes and the points are at any angles θ_1 and θ_2 measured from the diameter of commutation.

Railways in Europe.

It is stated that there are at present more miles of electrical railways in the city of Boston than in the whole of Europe.

Practical Notes on Dynamo Calculation—XXI.

BY ALFRED E. WIENER.

39. *Relative Permeances in Dynamo-Electric Machines.*

(*a.*) *Principle of magnetic potential.*

In taking the magnetic potential between two polepieces of opposite polarity as unity for calculating the relative permeances in dynamo-electric machines, the potentials between various points of the magnetic circuit depend upon the number of electromagnets magnetically in series between two consecutive poles of opposite polarity.

If, as is the case in the majority of types, there are two magnets between any north pole and the next south pole of the machine, then the magnetic potential between two points, x and y (Fig. 57) of the magnetic circuit separated by but one electromagnet, is $= \frac{1}{2}$; and two points, y and z, of the magnet-frame not separated by any exciting coil, have no differenee of magnetic potential, their potential $= 0$. If the circuit consists of but one electromagnet, or of several magnets magnetically in parallel, then the magnetic potential between any two leakage surfaces of opposite polarity is $= 1$, *i. e.*, equal to the difference of magnetic potential between the polepieces.

The observance of this general principle enables us to bring all the relative permeances into proper relation to each other, and we can now apply formulæ (112) to (118) to the cases of a dynamo.

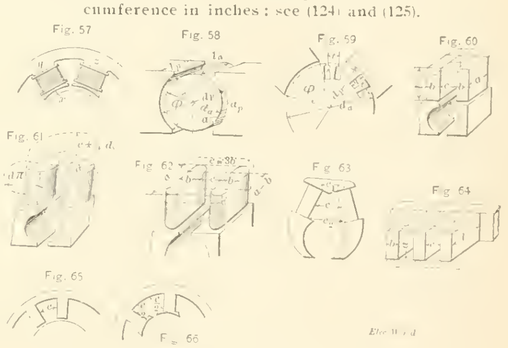
(*b.*) *Relative Permeance of the Air-Gaps* (P_1).

According to (112) the relative permeance of the air-gaps can be expressed by

$$P_1 = \frac{A_g}{l_g}, \quad \ldots\ldots\ldots\ldots (119)$$

if A_g = area of gap-spaces, *i. e.*, the mean of pole area and surface of armature core in sq. inches, see formula (120),

and l_g = mean distance between polepieces and armature-circumference in inches; see (124) and (125).



FIGS. 57, 58, 59, 60, 61, 62, 63, 64, 65 AND 66

the *mean area* of the gap-space for any armature facing poles opposite its *outer* periphery is given by the equation:

$$A_g = \tfrac{1}{2}\,(a_a + a_p) \times \tfrac{1}{2}\,(l_a + l_p) \quad \ldots\ldots (120)$$

where a_a = half perimeter of armature-core, in inches;

for *smooth* cores (Fig. 58): $a_a = \frac{d_a \times \pi}{2}$ .... (121)

for *toothed* cores (Fig. 59): $a_a = \frac{d_a \times \pi}{2} + n \times q$ .. (122)

d_a = diameter of armature core, in inches;
n = number of teeth;
q = depth of slots, in inches;

a_p = circumference of half the polepieces, in inches;

$$a_p = d_p \times \pi \times \frac{P \times \phi}{360} \quad \ldots\ldots\ldots\ldots (123)$$

d_p = diameter of bore of polepieces, in inches;
p = number of pairs of magnet poles;
ϕ = angle embraced by each pole;
l_a = length of armature core, in inches;
l_p = length of polepieces in inches.

The *mean length* of the field-path, in both gaps, according to chapter 48 is:

For *smooth* armatures: $l_g = k_{13} \times (d_p - d_a)$, ... (124)

and for *toothed* armatures: $l_g = k_{13} \times (d_p - d_a) + \frac{s \times q}{s + t}$ .... (125)

d_a = diameter of armature-core, in inches; } Figs. 58 and 59.
d_p = diameter of bore of field, in inches; }
s = width of slots, in inches;
t = width at top of teeth, in inches; } Fig. 59.
q = depth of slots, in inches; }
k_{13} = factor of field deflection; see Table LVI in chapter 48.

Combining formulæ (120), (121), (123) and (124), and formulæ (120), (122), (123) and (125) respectively, the relative permeance of the air-gaps, for smooth and for toothed armatures, respectively is obtained.

For *smooth* armatures we have:

$$P_1 = \frac{A_g}{l_g} = \frac{\frac{1}{2}\left(\frac{d_a \pi}{2} + d_p \pi \times \frac{p \times \phi}{360^\circ}\right) \times \frac{1}{2}(l_a + l_p)}{k_{13} \times (d_p - d_a)}$$

$$= \frac{\frac{1}{8}\left(d_a \pi + d_p \pi \times \frac{p \times \phi}{180}\right)(l_a + l_p)}{k_{13} \times (d_p - d_a)} \quad \ldots\ldots\ldots (126);$$

and for *toothed* armatures:

$$P_1 = \frac{A_g}{l_g} = \frac{\frac{1}{2}\left[\left(\frac{d_a \pi}{2} + n \times q\right) + d_p \pi \times \frac{p \times \phi}{360^\circ}\right] \times \frac{1}{2}(l_a + l_p)}{k_{13} \times (d_p - d_a) + \frac{s \times q}{s + t}}$$

$$= \frac{\frac{1}{8}\left(d_a \pi + d_p \pi \times \frac{p \times \phi}{180} + n \times q\right)(l_a + l_p)}{k_{13} \times (d_p - d_a) + \frac{s \times q}{s + t}} \quad \ldots\ldots\ldots 127.$$

For armatures revolving *outside* of a magnetic field, (*inner-pole type*), in the denominator of formula (125) the order of the diameters d_a and d_p is to be reversed, as in this case, d_a, the *internal* diameter of the armature-core, is larger than the diameter of the field.

If poles are situated *interior* as well as *exterior* to the armature, the mean of the outer and inner gap-areas has to be taken, by applying formula (120) to the inner diameter as well as to the outer diameter of the core; and instead of $(d_p - d_a)$ the sum of the outer and inner gaps is to be substituted.

In case of armatures, finally, facing the poles in the *axial* direction, (*flat ring type*), the gap area, if polepieces are used, is the mean of half the pole-area and the ring-area of the armature core; and if no separate polepieces are employed, is practically equal to half the sectional area of the magnet-cores. The mean length of the path is the difference between the axial pole-distance and the axial breadth of the armature-core, multiplied by the factor of field-deflection.

(*c.*) *Relative average permeance across the magnetic cores* (P_2).

Since in dynamo-electric machines the magnet cores, with their ends averted from the armature, are magnetically joined by special "*yokes*," or by the frame of the machine, forming the magnetic return circuit, the magnetic potential between these joined ends is practically $= 0$, while the full magnetic potential is availing between the free ends towards the armature. The *average* magnetic potential over the whole length of the magnet-cores, therefore, is one half of the maximum potential, and the *average relative permeance*, consequently, one half of that which would exist between the cores if they had the same magnetic potential all over their length.

For the various forms of magnetic cores by means of formulæ (113) to (118) respectively, we therefore obtain the following relative average permeances:

1. Rectangular Cores.

The permeance between two rectangular magnet-cores, Fig. 60, is the sum of the permeances between the inner surfaces which face each other, formula (114), and between the end-surfaces which lie in the same plane, formula (115), and therefore the average permeance is

$$P_2 = \frac{a \times l}{2\,c} + \frac{b \times l}{c + b \times \frac{\pi}{2}}, \quad \ldots\ldots\ldots\ldots\ldots (128)$$

where a, b, c and l are the dimensions of the cores, in inches, as in Fig. 60.

2. Round Cores.

According to formula (117) we have in this case (see Fig. 61):

$$P_2 = \frac{1}{2} \times \frac{d\,\pi \times l}{c + .75\,d} = \frac{d\,\pi \times l}{2\,c + 1.5\,d} \quad \ldots\ldots\ldots\ldots (129).$$

3. Oval Cores.

For oval cores, Fig. 62, the permeance path consists of two parts, a straight portion between the inner surfaces, and a curved portion between the round end-surfaces. Combining, therefore, formulæ (114) and (117) we obtain:

$$P_2 = \frac{(a - b) \times l}{2\,c} + \frac{b\,\pi \times l}{2\,c + 1.5\,b} \quad \ldots\ldots\ldots (130).$$

4. Inclined Cores.

If the cores, instead of being parallel to each other, are set at an angle, Fig. 63, the distance, c, in formulæ (128), (129) and (130) respectively, has to be averaged from the least and greatest distance of the cores:

$$c = \frac{c_1 + c_2}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (131)$$

5. Multipolar Types.

In case of multipolar dynamos of p pairs of poles, the total permeance across the magnet-cores is $2p$ times that between each pair of the cores. In calculating the latter, it has to be considered that while the permeances across two opposite side-surfaces does not change by increasing their number, the leakage across two end-surfaces is reduced, half of the lines leaking to the neighboring core at one side, and half to that on the other side.

For *rectangular* cores, therefore, we have, with reference to Fig. 64:

$$P_2 = 2\,p \times \left(\frac{a \times l}{2\,c} + \frac{\frac{1}{2}\,b \times l}{c + b \times \frac{\pi}{4}}\right) = p \times \left(\frac{a \times l}{c} + \frac{b \times l}{c + b\frac{\pi}{4}}\right); \; (132);$$

for *round* cores, according to formula (118):

$$P_2 = 2\,p \times \frac{d\,\pi \times l}{2\,(2\,c + .6\,d)} = p \times \frac{d\,\pi \times l}{2\,c + .6\,d} \; \ldots\ldots (133),$$

and for *oval* cores:

$$P_2 = p \times \left(\frac{(a - b) \times l}{2\,c} + \frac{b \times \pi \times l}{2\,c + .6\,b}\right) \ldots\ldots\ldots\ldots (134),$$

In multipolar machines for c the smaller of either the mean distance between two magnets, Fig. 65, or twice the mean distance between magnet-core and yoke, Fig. 66, is to be taken.

(*d*) *Relative permeance across polepieces* (P_3).

The amount of leakage across the end and side-surfaces of the polepieces, that is, across all their surfaces not facing the armature core, depends upon the slope of the polepieces, and upon the design of the machine with reference to an actual iron surface (bed-plates) near the polepieces.

By the principle of the magnetic potential the *actual* permeance, according to formula (112), in this case, is also the "*relative*" one, as the magnetic potential between two polepieces of opposite polarity is unity.

The respective relative permeance for the various shapes of polepieces can, therefore, easily be deduced by means of formulæ (113) to (118), chapter 38.

(*e*) *Relative permeance between polepieces and yoke* (P_4).

According to the general principle of calculating relative permeances, the magnetic potential between polepieces and yoke is to be taken $= \frac{1}{2}$, with reference to the potential between two polepieces of opposite polarity. For the yokes serve to join two magnet-cores in series magnetically, and are therefore separated from the polepieces by but one electro-magnet. If the yokes join the magnets in parallel, then they usually serve as polepieces also, and must be considered as such in leakage calculations.

Since the amounts of the leakages in the various paths are proportional to their permeances, in dynamos having an external iron surface near the polepieces, most of the leakage takes place between the polepieces across that external surface; and in such machines the leakage from the polepieces to the yoke is comparatively small.

The value of the relative permeance between polepieces and yoke, for every, individual case, consequently, is obtained by taking one half of the respective actual permeance, as calculated from formulæ (112) to (118) respectively.

NOTE.—The end of Chapter 36, page 598, should read: "Prof. Forbes' logarithmic formulæ* heretofore employed, etc."

* Silv. P. Thompson, Dynamo Electric Machinery, 4th Edition, page 186.

Formula (113), page 599, should read:

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{c + \frac{a_1 + a_2}{2} \times \frac{\pi}{2} \times \frac{a}{180^\circ}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (113).$$

In paragraph referring to Fig. 54, sub (c), page 599, $y = \frac{\text{[illegible]}}{4}$ should be replaced by $y = \frac{d}{4}$.

In section (f) of Chapter 38, read $c + \cdot 3\,d$, instead of $C + \cdot 3\,d$.

(To be continued.)

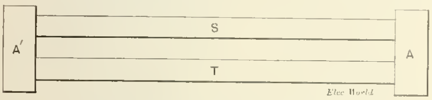
A Method of Determining Induction and Hysteresis Curves.

BY FRANK HOLDEN.

If a magnetic circuit of uniform cross-section be composed of parts of different permeability, and magnetomotive forces be applied uniformly along the length of each section having values inversely as the permeabilities of the sections to which they are applied, there will then be no external field from this arrangement and the magnetomotive forces will be easily calculable if all the dimensions be known, as shown in Gray's "Absolute Measurements in Electricity and Magnetism," Vol. II., page 281.

Perhaps the simplest arrangement of this is that shown in the accompanying cut, in which A and A' are two blocks of soft iron drilled so that the two rods, which are uniformly wound from block to block, may fit well into them. Means for varying and measuring independently the current in each coil is provided, and the coils are so connected that if the coil for the bar S magnetizes from A to A' then the coil for T magnetizes from A' to A. A sensitive magnetometer is placed so as to best show any external field between A and A'.

Knowing the induction curve of S, then by this arrangement may that of T be found. For by a variation of the currents the condition may be brought about such that there is no leakage between A and A', and then the inductions in the two bars are necessarily equal and the magnetizing force for each bar during this condition is calculable from the distance between the blocks, L, and the number of turns N, and the currents in the coils C, $\mathfrak{C}$ being $\frac{4\,\pi\,N\,C}{10\,L}$.



A Method of Determining Induction and Hysteresis Curves.

By reference to the induction curve of S, the induction value is found for S and consequently for T. The magnetomotive force being calculated, one point in the curve for T is determined, and the others may be similarly found. During the adjustments of the currents, they must be frequently and simultaneously reversed to prevent any indefiniteness because of hysteresis.

By a somewhat similar procedure, the hysteresis curve of T for a certain maximum induction may be found if that of S for the same induction be known. The current for S is made to equal that needed to produce the maximum induction, determined by reference to the known curve and while both are being reversed, the current for T is varied until there is no leakage. The value of this current and reference to the known curve determine the highest point of the desired curve. The current for S is then decreased to a certain value and that of T decreased until again there is no leakage. The magnetomotive force for each bar is then calculable and the induction found by reference as before to the known curve. This is continued until the currents arrive at the same numerical value but reversed, when one side of the curve will be determined.

Although it complicates calculation a little, yet it is possible to use bars of different cross-sections and so give the apparatus greater range. The bars may be used of such a length that the reluctances at the joints do not have an appreciable effect, so much so that sheet iron is easily tested in this manner.

Based on this magnetic arrangement, it is theoretically possible to build an apparatus that will draw the desired curve and integrate it at one operation so that the hysteresis loss may be read directly without calculation.

Where Professors Unbend.

Even the professors, according to a London contemporary, cease to be professional at the friendly meetings of the Physical Society and do not treat their audience like a class of naughty boys.

Electrical Power Transmission—IV.

BY LOUIS BELL, Ph. D.

Power Transmission by Continuous Currents.

23. Up to the present time by far the largest part of electrical power transmission has been done by continuous currents. All the earlier plants were of this type, and even now, when transmission by alternating currents, polyphase and others, is pushing rapidly to the front, the older type of apparatus is still being installed on an extensive scale, and on account of the large number of plants now in operation, even if for no others reason, will probably remain in use for a long time to come. New power transmission plants, both here and abroad, are more and more frequently installed with alternating currents, and in many cases this practice is almost

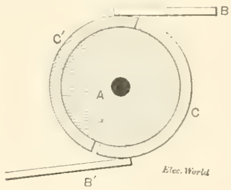


Fig. 9.

absolutely necessary, but there still remain many cases wherein the conditions are as well or better met in the old-fashioned way.

Chief among these may be mentioned electric railway work, which in America alone probably requires not less half a million horse power in generators and motors. Certain difficult work at variable speed and load, and many simple transmissions over short distances are at present best handled by continuous current machinery. As alternating practice advances many, perhaps all, of these special cases will be eliminated, but we are dealing with the art of power transmission as it exists to-day, and hence continuous current working deserves very careful consideration.

24. The broad principle of the continuous current generator has already been explained, but its modifications in actual work are important and worthy of special investigation. In a general way, continuous currents are almost always obtained by commuting the current obtained from a machine which would naturally deliver alternating currents. This process is, however, by no means as simple as Fig. 9 would suggest. With a two-part commutator the resulting current, although unidirectional, would necessarily be very irregular owing to the fact that the total current drops to zero at the moment of commutation. Such a current is ill fitted for many purposes, and the commutator would be rapidly destroyed by sparking if the machine were of any practical size.

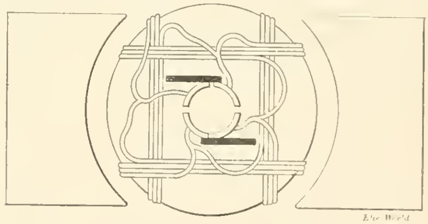


Fig. 10.

To avoid these difficulties, the number of coils on the armature is increased and they are so interconnected that, while each coil has its connection to the outside current reversed as before, when its electromotive force is zero, the other coils in which the E. M. F. still remains in the right direction continue in circuit unchanged. In this way the E. M. F. at the brush is the sum of the E. M. F.'s of a number of coils, each of which is reversed at the proper moment. The number of commutator segments is increased proportionally to the number of coils and the commutator thus becomes a comparatively complicated structure. The result, however, is that the total E. M. F. of the armature only varies by the variation in a single coil. The nature of this modification is shown in Fig. 10 which shows a four-part commutator connected to a four-coil armature.

An eight-part winding modern type is shown in Fig. 11. Tracing out the currents in this will give a clear idea both of a typical winding and of the process of commutation.

In commercial machines the number of individual coils and of commutator segments often exceeds 100, but the principle of the winding is the same. Nearly all the early dynamos had several turns of wire per coil, as in Fig. 10, but at present, in all large machines at least, one turn constitutes a complete coil. This extreme sub-division is to avoid sparking at the commutator, which becomes destructive if the current be large and the E. M. F. per commutator segment great.

If each coil generates a considerable voltage there is even under the best conditions of commutation a strong tendency for sparks to follow the brush across the insulation between segments or even to

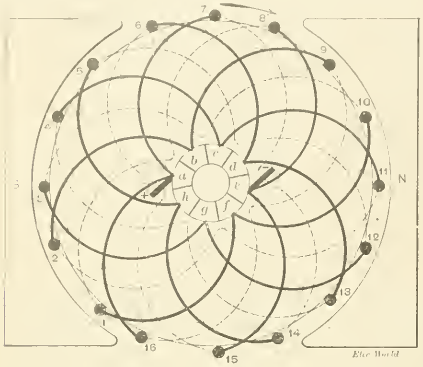


Fig. 11.

jump across this insulation elsewhere. As this goes from bad to worse and rapidly ruins the commutator, every precaution has to be taken against such a contingency. The E. M. F. generated by each coil is kept low by sub-dividing the winding, and in large machines it is the rule that the E. M. F. of a single loop is quite all that can safely be allotted to a single commutator segment.

Present good practice indicates that for generators for lighting up to 100 or 150 volts the voltage between brushes should be subdivided so that it shall not exceed three or four volts for each segment between the brushes. For 500 or 600 volt machines it should not exceed 10 or 12 volts, while for dynamos of still higher voltage it may rise to 20 volts or more. The reason for these different figures is that the destructiveness of the spark depends on the amount of current which is liable to be involved. On a low voltage commutator intended for heavy currents, even very moderate sparking may gnaw the segments seriously while the spark of an arc machine in spite of its venomous appearance may do very little harm, as the maximum current in the whole bar will not exceed 8 or 10 amperes. Consequently the voltage per bar in such cases is sometimes 50 or more, while in very large incandescent machines and in

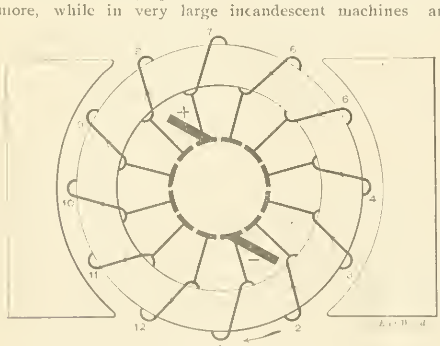


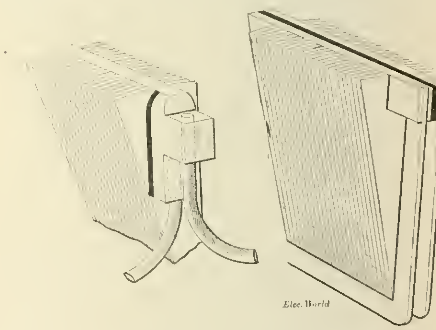
Fig. 12.

those designed for electrolytic purposes the E. M. F. per bar is often less than 2 volt, or even 1 volt.

25. Windings like those of Fig. 10 and 11 are of the so-called *drum* type in which each convolution extends around the whole body of the armature, either diametrically or nearly so. Another sort of armature winding frequently used, although less now than formerly, is the *Gramme* so called from its inventor. Here the iron body of the armature is, instead of being cylindrical, in the form of a massive ring of rectangular cross section. The windings are looped through and around this ring, fitting it firmly and closely. Fig. 12, which shows in diagram a winding in ten sections, furnishes a good example of the Gramme construction. There may be one or several turns per coil, as in drum windings. These two general types of windings are used with various modifications in nearly all continuous current dynamos. Each has its good and bad features. The Gramme winding makes it very easy to keep down the voltage per segment, inasmuch as for each wire under induction there is a commutator bar, while in the drum form there is but one bar for two wires. It is also mechanically solid even when wound with small wire, and no two adjacent wires can have a considerable voltage between them, thus making it easy to build an armature for high E. M. F. On the other hand, the drum winding gives a very compact armature of easy construction, and the magnetism induced in it is less likely to disturb that of the field.

In the small machines once usual the Gramme type was preferred for high voltages on account of the ease with which it could be repaired, while the drum was liked for its simplicity of mechanical construction as a whole and excellent efficiency as an inductor. In modern practice the differences between these types have become much less marked. With large units, particularly of the multipolar form now usual, the drum winding is as easily insulated as the Gramme, for with the winding now used in such cases there need be no considerable voltage between adjacent wires, and repairs are of very infrequent occurence. In fact, the drum winding can be made quite as accessible as the other, and is on the whole cheaper and simpler. Almost the sole advantage of the Gramme (*or ring*) winding is that of low voltage per commutator bar. Mechanically, too, there is less difference than formerly, for the coils are in both types frequently bedded in slots in the iron of the armature core.

26. It must be noted that the armature of the modern dynamo, unless



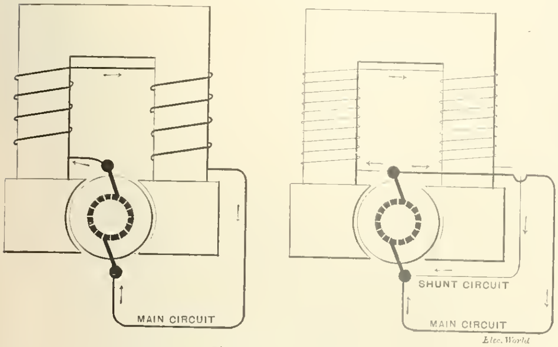
Figs. 14 and 13.

of small size or unusually high voltage, is seldom wound with wire in the ordinary sense of the word. Instead, the conductors are bars of copper, often of sections rectangular rather than round, and generally lacking any permanently attached insulation. Whatever the winding, the conductors on the armature face are enclosed in close fitting tubes of mica and specially treated paper or the like, and then put in place on the armature core or in more or less completely closed channels cut in it. If on the core surface, the bars are not generally insulated on the exterior surface at all. If the armature core be slotted, the insulating material is preferably put in position first and the bar put in afterwards. As to the rest of the winding it is completed by connectors of copper strip or rod soldered to the face conductors and insulated in a substantial manner. Thus each convolution, whether of ring or drum winding, is composed of from two to four pieces.

A typical modern ring winding is shown in Fig. 13. It well exemplifies the construction above mentioned and in this case the insulated faces of the exterior conductors form the commutator of the machine. Such a construction of course includes iron clad armatures and is best fitted for a machine having a field magnet inside the ring armature. A similar arrangement which avoids the above limitations, uses the side connectors of the ring as commutator segments. The general principle, however, is the same, whether the commutator forms part of the winding proper or is a separate structure.

An iron clad drum winding of typical character is shown in Fig. 14. Here the exterior bars are fitted into thoroughly insulated slots in the core, and wedged firmly into place by insulating wedges.

Sometimes the bars themselves are shaped so as to act as wedges. In either case the bars are held almost as solidly as if they formed an integral part of the core. The commutator in these windings must be a separate affair. Fig. 14 shows well the nature of the winding, with its slotted core, dense insulation, and massive bars—in this example one per slot. The end connectors lie in a pair of reverse spirals, one outside the other, and separated by firm insulation. The relation of these connectors to the rest of the winding is illustrated in Fig. 11.



FIGS. 15 AND 16.

Between the modern drum and ring armatures it is difficult to discriminate. Both have been successfully used in dynamos of the largest size, but the iron clad drum is in the more general use. It is rather unusual to find a standard generator of recent build and of 100-kw or more output with a regular wire wound armature, and the most of them have some modification of the bar windings just described.

27. We have briefly reviewed here the armature windings at present in general use and may now pass to the various windings employed for the field magnets. These are, in continuous current dynamos, almost always connected and supplied with current from the armature winding, thus making the machines self exciting. As the armature is turned the action begins with the weak residual, magnetism left in the field magnets, and the current set up by the small E. M. F. thus produced is passed around, gradually strengthens the magnets, building them up to full strength. If this residual magnetism is very feeble, as may happen when it is knocked out of the iron by rough handling or the continual jarring of a long

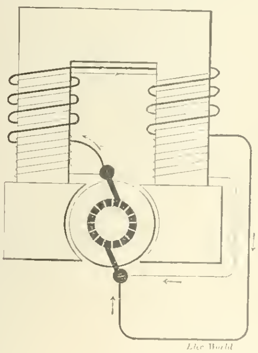


FIG. 17.

journey, it is sometimes quite difficult to get the machine into action.

The simplest form of field winding, and the one which was most extensively used at first, is that in which the current from one of the brushes passes around the field magnet coils on its way to or from the external circuit of the machine, as shown in Fig. 15. This *series* winding possesss more than one advantage. It consists of a comparatively small number of convolutions of rather large wire and so is cheap to wind; it is, for this same reason, less liable to injury and easier to repair when injured; and what is of particular importance, whenever the series dynamo is called upon for more current, the magnetizing power of the fields is raised by the increase, thus increasing the electromotive force. This property, once considered a disadvantage, becomes of great value in modern windings adapted for the purpose. As the generation of E. M. F. at the start depends entirely on the residual magnetism, series wound machines do not "build up" full voltage very easily unless the resistance of the outside circuit is fairly low, thus giving the current a chance.

The common shunt winding shown in Fig. 16 almost describes itself. The brushes are, independently of the exterior circuit, connected to magnetizing coils of fine wire. Although such a field winding is slightly harder to construct and maintain, it produces a magnetic field that is relatively free from any actions in the working circuit of the machine. So long as the E. M. F. at the brushes is unaffected by changes of speed, the field will be quite steady except as a very large current in the exterior circuit may reduce the voltage available for the field by causing a loss of voltage in the armature. If the armature resistence be very small, there will be almost a constant E. M. F. at the brushes except as the current flowing in the armature may produce a magnetization opposed to the shunt field. For a considerable time, then, the shunt winding was always used when a constant E. M. F. was required. At the same time, it permits the E. M. F. to be varied, if desired, with a very small loss of energy, by the simple expedient of putting a variable resistance in circuit with the field magnets.

As the principles of dynamo construction became better known, it was apparent that the above method of getting a constant E. M. F. was rather expensive. To build an armature that would carry a heavy current without noticeable loss of voltage and to enclose it in fields so strong as to be disturbed only in a minute degree by the magnetizing effects of such currents, is a task requiring much care and a great amount of material. Even if this difficult problem were solved, the constant voltage would be at the brushes of the machine and not at the load where it is wanted.

An easy way out of these difficulties is found by considering an important property of the series wound machine just mentioned, *i.e.*, the rise of E. M. F. as the load on the external circuit rises. If now one takes a good shunt wound dynamo and adds to the field magnets a few *series* turns wound in the same direction as the shunt, the result is as follows: At no load, the voltage at the brushes is that due to the shunt alone. As the load comes on this would naturally fall off owing to the loss of voltage from armature resistance and reaction. The series turns, however, at this juncture strengthens the field and thus compensates for these losses. This is the *compound winding* now very generally used. It is shown in diagram in Fig. 17. Ordinarily the series turns are more than would be needed for merely compensating the losses due to armature resistance and reaction, so that the voltage at the brushes under load will rise enough to make up for the increased loss in the line due to carrying heavier current.

Machines thus *over-compounded* five or ten per cent are in quite common use.

(To be continued.)

Inventors and Inventions.

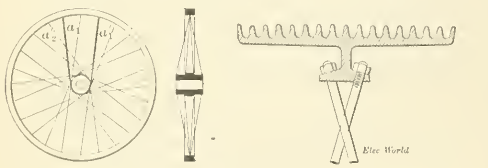
In a recent address, Mr. Alexaner Siemens said that it is a popular superstition that the inventors are heaven made, and that they can produce useful novelties to order in any branch of manufacture where a want exists, if only their attention is drawn to it. "The history of the invention of the steam engine," he added "is a well known illustration of the point I wish to emphasize. According to the popular version, Watt, a small boy, saw the lid of a tea kettle move up and down, when the water was boiling, and this suggested to him the construction of a steam engine. As a matter of fact, Watt made himself acquainted with what had been done before (a point altogether ignored in the popular version), and had to work very hard before he brought his invention to a successful issue. His example is typical of the true method of progress, and we may generally say that in order to approach a problem with the most certain prospect of success it is necessary:—(1) To define, as accurately as possible, the want that exists, or the particular object that is to be attained. (2.) To be well acquainted with the scientific principles which come into play. (3.) To know how the want is met, or the object attained in practical life. (4.) To find out what proposals have been made by others in the same or in a similar case. A careful attention to these requirements will prevent much disappointment and waste of energy, as will be obvious to all of you without further explanation."

Fly-Wheel Accidents.

BY ARCHIBALD SHARP.

I have read with interest the discussion on fly-wheel accidents which has been going on in your journal. The conclusion drawn from the discussion, that "cast iron fly-wheels are engineering absurdities, and that the governor is probably the most important piece of apparatus in a power house," may be true with reference to the existing types of large cast iron fly-wheels; but I hope to show below that a fly-wheel with a cast iron rim can be made with a sufficient margin of safety to meet heavier demands than have yet been made upon them.

In considering the stresses to which a fly-wheel is subjected, a clear distinction must be made between (1) the stresses existing when the wheel is running *uniformly* at a high speed; and (2) the stresses imposed by a sudden alteration of the speed. In the first case, if the power is not taken by belts or ropes from the rim.



FIGS. 1, 2 AND 3.

the stresses are simply called into existence by the centrifugal forces due to the speed, presuming there are no initial stresses on the wheel while at rest. If the rim could revolve freely without constraint at the arms, as would be the case if the arms fitted loosely into radial holes in the rim, the centrifugal force would produce a uniform circumferential tension on the rim, given by the formula, $\frac{s\,v^2}{g}$, s being the weight of one foot, length of rim one square inch in section and v the linear velocity of the rim in feet per second. At a speed of 100 feet per second, this stress only amounts to .469 tons per square inch, and this low stress even the much maligned material cast iron may be safely entrusted to bear. But the fact that the arms are rigidly fastened at the rim interferes with the above condition of affairs; and each rim segment, under the action of the centrifugal forces and the radial constraint of the arm, is practically in the condition of a beam uniformly loaded and supported at its middle point (if the rim joints be midway between the arms), or at its two ends (if the rim joints be at the ends of the arms). The stresses due to this bending, combined with the existing initial stresses, must be relatively far higher than the circumferential stress, and probably account for the breakup of many a fly-wheel.

If w be the radial centrifugal forces per foot run, and l the length of a segment, then the maximum bending moment on a rim segment is proportional to wl^2. Thus keeping the section of the rim constant, the maximum bending stresses on the rim due to centrifugal force are proportional to the square of the number of arms, and a means of improving the design of a cast iron fly-wheel is suggested.

If the power be taken off from the rim by ropes or belts, in addition to the above stresses there will be a constant tangential effort transmitted from the arms to the rim, which may increase the maximum bending stresses.

In case (2) when the fly-wheel is being accelerated or retarded by a diminution or increase of load, a considerable tangential effort is transmitted by the arms from the nave to the rim. This tangential effort will in many cases be very much greater than that due to the steady driving at full load. The bending stresses on the arms due to this effort may be greater than they can carry and fracture will occur. If a fly-wheel bursts from this cause alone, centrifugal stresses being low, it is possible that all the arms may be broken and the rim left intact. Is any such case known?

The use of cast iron for fly-wheel arms seems to me to be utterly out of place; in no other important structures subjected to shock are large cast iron members subjected to transverse stress; even the use of cast iron for beams of short span carrying steady loads is being gradually discarded, while engine beams of cast iron are things of the past.

Prof. Thurston remarks "that the charge of steam just taken into the cylinder is sufficient to accelerate its speed to the danger point with a weak and faulty wheel." Now the fly-wheel ought to be made sufficiently powerful to allow the full power of the engine to be expended in simply accelerating its speed, and yet take sufficient time to arrive at the danger point to allow the attendant reasonable time to shut off the steam. This seems to me to be the last and safest resource, as any automatic apparatus, however carefully designed, may be liable to derangement at the critical moment. In such a case a few minutes, even seconds, are valuable, and with a *powerful* fly-wheel the increase of speed will be so slow as to afford the necessary time.

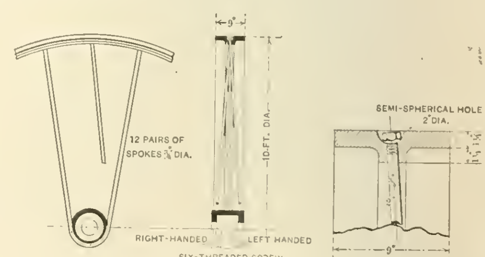
Mr. Field suggests better proportioned and heavier fly-wheels. I presume by heavier he means more powerful wheels; with the design of fly-wheel described below the "powerfulness" is obtained not by an increase of weight but by an increase of speed of rim.

Mr. H. Ward Leonard suggests that the fly-wheel should have a solid web made of boiler iron, and a rim similarly built up of boiler iron riveted together. Such a wheel might be safe, but I am afraid that its cost would be prohibitive.

I trust the following design will satisfy Mr. G. T. Hanchett, as a realization of the ideal fly-wheel, though it is not built in the manner he suggests.

A description of my fly-wheel has already been given, on your side of the water, in a paper* by Mr. John Galt, C. E., before the Canadian Association of Electrical Engineers, on "Improved Regulation by Fly-wheel Accumulatros." The distinctive features of the design are illustrated in Figs. 1 and 2. The nave or hub of the wheel is suspended from the rim by a series of steel loops, one loop forming a *pair* of spokes. One loop or pair of spokes is shown thickened in Fig. 1. The ends of the spokes are fastened to the rim by nuts. There is absolutely no fastening of the spokes to the nave beyond that due to friction. The spokes are spread laterally in the manner usually adopted in bicycle wheel construction. The part of a loop in contact with the nave is formed spirally so that all the ends of the spokes on one side of the middle plane begin contact with the nave at the same distance from the middle, and the other ends leave the nave nearer the middle plane. In the wheel shown in Figs. 1 and 2, there are twelve pairs of spokes, that is, six pairs on each side of the middle plane; so that if the parts in contact with the nave lie in grooves, these grooves will form practically a six-threaded screw. Fig. 3 is a design of the section of rim for a rope fly-wheel, and Fig. 4 is a design for a high speed fly-wheel for a gas engine at a lighting station. This wheel construction is applicable to all kinds of built up wheels; from bicycle wheels—for which it has been tested over a period of two years—up to the largest class of fly-wheels. In the heaviest class of rope or belt pulley fly-wheel a considerable proportion of the weight, up to in many cases 20 per cent., is in the nave and arms, which, moving at a low linear speed, contribute little or nothing to the storage capacity. The cost of machining, fitting and erecting these arms is considerable, so that my wheel with its light steel spokes, with little or no workmanship required on them, will compare favorably in price with the wheels of the older type.

Again, the rim being supported by numerous spokes, there are practically no bending stresses on the rim, so that a wheel with cast iron rim can be safely run at a much higher speed than is attempted at present. The energy stored varying with the square



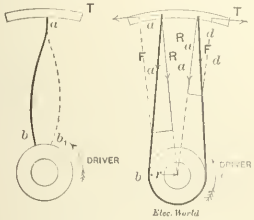
FIGS. 4 AND 4*a*.

of the speed, increasing the speed is a much better means of increasing the powerfulness of a fly-wheel, than increasing the weight.

A fly-wheel built on this system must not be confounded with a wrought iron pulley of the usual type, with radial spokes. In wrought iron pulleys—and in fact with cast iron wheels with radial arms—the arms or spokes, which are straight when the wheel is at rest, will each be bent (as shown exaggerated at *ab* (Fig. 5) when the effort is being transmitted from the nave to the rim, in the direction of the arrow. If the direction of the driving effort be reversed, and the rim overrun the nave, the spoke will be bent as

* Abstracted in The Electrical World, September 29, 1894.

shown by the dotted line ab. Thus the radial spokes constitute a slightly flexible coupling between the rim and the nave, so that the rim may be moving with practically uniform velocity, while the fluctuations of velocity of the nave may be considerable. In my patent fly-wheels and pulleys the action of the spokes is entirely different. Fig. 6 is a sketch showing one pair of spokes in its relation to the nave and rim. When the wheel is at rest, or rotating with uniform velocity, the tensions on the two ends of the spokes are equal. When effort is being transmitted from the nave to the rim in the direction of the arrow, the pully F_a on the portion ab of the pair of spokes is a little greater than the initial pull; while the pull F_d on the portion dc is a little less. The difference between F_a and F_d is taken up by the frictional grip of the portion bc on the nave. The difference $(F_a - F_d)$ multiplied by r, the radius of the nave, gives the twisting moment transmitted per pair of spokes. Another method of considering the action is the following: The forces F_a and F_d acting on the rim at a and d respectively, may be resolved into radial and tangential components T_a R_a and



FIGS. 5 AND 6.

T_d, and R_d respectively. The radial components R_a and R_d have no effect in accelerating or retarding the motion of the rim, so the resulting force accelerating the rim is $(T_a - T_d)$ per pair of spokes.

The initial tension on the spokes, due to screwing up the nuts, produces an initial circumferential compression in the rim. At a certain speed of rim the centrifugal forces will just neutralize this compression, and the circumferential stress on the rim will be zero. At a higher speed the circumferential stress will be tension. Owing to the existence of this initial compression a velocity of 200 feet per second will be quite safe with a rim of cast iron. The centrifugal tension in the rim due to its own weight at this speed is 1.87 tons per square inch; it will be reduced by the initial tension on the spokes, the amount of reduction depending on the number of spokes.

A rim of mild steel may be safely run at 300 feet per second; at this speed one ton weight of rim stores 94.85 horse power minutes; while for a variation of speed 5 per cent. above and 5 per cent. below the average, an available energy of 18.97 horse power minutes per ton weight of rim is obtained. Such a high speed fly-wheel would be most conveniently placed on the dynamo shaft. An engine of 740-hp. with a ten-ton fly-wheel running at 300 feet per second, if allowed to run *full power with no load* would take one minute to increase its speed by one-third. This would give the attendants ample time to shut down the steam stop valve in case of accident; and even if no attendant was at hand and the speed still further increased, the wheel would first give way by the spokes and rim increasing in size, the rim would ultimately press against the bottom of the pit in which it runs, and thus form an effective brake which would prevent further increase of speed and further damage.

The above design is confidently offered as a solution of the fly-wheel problem. I hope to be able to give some figures in the course of a few weeks, as to the relative performances of a gas engine driving a dynamo with ordinary fly-wheels, and with a lighter high speed fly-wheel of my construction.

Another Competition of Self-Contained Vehicles.

A French contemporary states that it is proposed to organize a new competition of self-contained carriages, and that the comfort of passengers will not be studied as in the case of the *Petit Journal* contest, but that awards will be made to those competitors whose vehicles attain the highest speed on a long route. The minimum distance to be traversed is 620 miles; the start will be made from Paris, to which city the carriages will return; and the vehicles admissable to the competition must be operated either by an electric motor, a steam engine, or a petroleum or similar motor. An organizing committee has already been formed, and it is intended to arrange for the competition taking place next year.

Fly-Wheel Accidents.

BY W. STUART-SMITH.

Mr. Coykendall, in his communication to The Electrical World, Oct. 13, took the ground that in some cases the wrecking of fly-wheels is due to a sudden strain thrown on them by the closing of the circuit breaker with a short circuit on the line. This statement has called forth an extended discussion by many eminent engineers. Some of the participants agree that such strains are sufficient to wreck the wheel, while others deny it, but no one has denied that closing the circuit breaker under the conditions named will cause the strains as claimed; nevertheless there is some ground for doubt as a consideration of the conditions will show. With the circuit breaker open the engine is running light and cutting off steam almost at the beginning of the stroke; the speed is at a maximum, say 2 to 4 per cent. above the normal, and the amount of stored energy in the fly-wheel is at a maximum. When the circuit breaker is closed there is certainly an increased load which requires to be taken up, but as the engine is running with a minimum amount of steam it is not in condition to take up this load, nor can it do so until through a reduction of speed the governor is enabled to alter the position of the eccentric sufficiently to materially increase the admission of steam. If the circuit breaker is closed when the piston is just beginning its stroke, full pressure will be upon the piston, but in this position it can exert no turning effort, and hence the engine cannot take up the load. If the closing occurs when the engine is on the half center the position would be right for the engine to take up the load, but it is unable to do so because it has no steam. As the engine cannot take up the load either at position of maximum pressure on the piston or maximum turning effort, it is evident no blow tending to wreck the wheel can come from the engine. As under the circumstances the engine cannot supply the power required to take up the load, it is necessary to have recourse to some other source of power for the purpose, and this is found in the stored energy of the fly-wheel, which, as above stated, is running at from 2 to 4 per cent above the normal. Thus when the circuit breaker is closed the stored energy of the fly-wheel must supply the initial power required to take up the load, and this withdrawal of stored energy will gradually reduce the speed from the high speed of light load to the speed of normal running. During the reduction of speed the power developed by the engine will gradually increase and it will transfer to itself the load which was at first assumed by the fly wheel. This transference will not be sudden but will be extended over the time required to reduce the speed, so that at no time will there be anything in a nature of a blow on the engine.

If the fly-wheel was not used as the driver the stored energy of the rim would have to be transmitted through the arms, which would in consequence be somewhat strained, but if the fly-wheel at the same time acted as driver the only strain on the arms would be that required to reduce by 2 to 4 per cent. the momentum of the piston, connecting rods and other moving parts, and it hardly seems possible any one can claim that this could have any injurious effect on the arms.

With the fly-wheel acting as a driver there will be some strain on the rim, and if the belt covers, say two-fifths of the circumference, the entire strain will at first come on this two-fifths, and if the rim is not sufficiently stiff it is possible that the wheel might be distorted sufficiently to cause the rim to break by transverse strain, but if the rim was stiff enough to retain its shape this action could not occur. With a stiff rim there is still another action tending to produce rupture. The retarding effort on the rim would be confined entirely to the two-fifths of the wheel covered by the belt, while the remaining three-fifths, being entirely free from the influence of the belt, would tend by its inertia to keep up its speed with the result that a tensile strain would be set up which would have a maximum value just at that point where the slack side of the belt was tangent to the face of the wheel. As the total reduction of speed would not be more than 2 to 4 per cent., and as to reduce the speed by this amount an appreciable time would be required, it hardly seems possible that closing the circuit breaker, under any conditions, can throw any dangerous strain upon the engine.

When, however, the circuit breaker opens there will be a different condition of affairs, as the engine will then be running with maximum steam and it might happen that the circuit breaker opened just as the crank was on the half centre, and with full boiler pressure (less the drop) in the cylinder. This would be the condition of greatest possible turning effort, and the instantaneous effort to increase the speed would be so great that there would be a strong tendency to shear the arms before inertia of the rim, armatures, etc., could be overcome.

Again, at the moment the short circuit occurs there would be a strain on the rim tending to cause it to collapse, as when the circuit breaker is closed with a short circuit on the line, and there would also be a strain on the arms tending to break them, because the tendency would be to check the speed of the engine at the time when it was putting forth its maximum turning effort. Thus when a shorter circuit occurs on this line and the circuit breaker opens, the arms receive two blows tending to break them transversely, and a strain comes on the rim tending to crush it, while at closing the cicruit breaker, the rim only receives the strain, and it is evident that Mr. Coykendall has laid great stress on the strain which is least dangerous.

Before the proportions of any piece of machinery can be properly fixed, it is of the highest importance that a careful study be made of the work it has to do, what strains it will be subjected to and how the straining forces are to be applied. In all works dealing with the proportions of fly-wheels, it is assumed that on the rim centrifugal force only will act while the only office of the arms is to transmit the driving power to the rim. This may possibly be true when the sole office of the wheel is to store energy during that part of the stroke when the engine is putting forth its maximum effort and supply energy when the engine is on or near the centers and capable of exerting little or no effort, *i. e.*, when its sole office is to act as a fly-wheel and steady the motion of the machinery, but when it at the same time must perform the double office of fly-wheel and driver a consideration of the conditions will show that the strains are by no means simple or the acting forces steady in the application, and it may be shown that the arms are subjected to other than transverse strains.

During the discussion which followed Mr. Coykendall's original communication to The Electrical World, it was repeatedly stated that wheels went to pieces on account of the tensile strains produced by the tangential component of the centrifugal force.

The fact that when a wheel goes to pieces the separate portions move forward in a tangential direction is no doubt responsible for this impression, which seems to be quite general.

A very little consideration will show that with a symmetrical

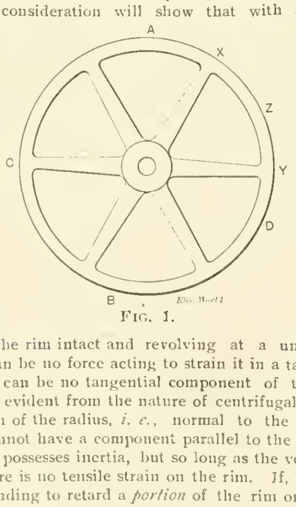


FIG. 1.

wheel having the rim intact and revolving at a uniform rate of speed, there can be no force acting to strain it in a tangential direction and there can be no tangential component of the centrifugal force. This is evident from the nature of centrifugal force. It acts in the direction of the radius, *i. e.*, normal to the surface at all points, and cannot have a component parallel to the surface. The mass certainly possesses inertia, but so long as the velocity remains unchecked there is no tensile strain on the rim. If, however, there is any force tending to retard a *portion* of the rim only the inertia of the remaining portion does exert a tensile strain at the point of application of the retarding force. During retardation or accelertion of the velocity of the wheel there will be forces tending to compress the rim forward of the arms and elongate behind them or half the space between the arms will be under compression and the other half under tension, but unless the retarding or accelerating force is applied very suddenly and the rim contains a flaw which makes a very weak point, these forces need not be taken into consideration.

If the rim suffers fracture, however, and a portion is no longer constrained to move out of the plane in which it was previously moving, centrifugal force is at once destroyed and its place taken by the force of inertia, which causes it to move forward in a tangential direction.

If the force tending to produce rupture was tangential, the rim strains would be tensile and would be very evenly distributed, but in reality the strains are unevenly distributed, as can be shown. The rim may be considered as a curved girder rigidly supported at regular intervals. In the sketch the space X Y between the two arms may be considered as a space over which the load is evenly distributed. In this case the load is the centrifugal force, the amount of which can be readily calculated for any groin wheel when the weight of the rim, diameter and number of arms are given the formula being $\frac{W V^2}{g r}$ when $W =$ the weight of the rim between two arms, $V =$ the linear velocity of the mean centre of the rim, $g =$ gravity, $r =$ the radius of the wheel.

The span is really an arch with the load applied from below instead of above, but a sufficiently close approximation to the strains will be obtained if it is considered as a straight span, and more especially as centrifugal force, which is the load, acts normally to the surface at all points instead of normal to the chord, as is usual with a loaded arch. The more nearly the arms are placed together and the larger the diameter of the wheel the more nearly the condition of a straight span is approximated. The greatest bending movement acts in the middle of the span, and is equal to $\frac{W L}{8}$ when $W =$ the total load on the span, or the centrifugal force for the span, and L is the mean curved length of the span. If a parabola be drawn having a chord equal to the length of the span on the curve, and the middle ordinate $c\ D = \frac{W L}{8}$, the other ordinates will represent the bending moments at other points of the span.

The maximum shearing stress at the point of support will be $\frac{W}{2}$ and the maximum deflection will be $\frac{W L^3}{76.8\ E I}$ when E is the modulus of elasticity, and I is the moment of inertia of the beam (or rim).

In order to see what these strains will amount to in practice, some data approximating to a wheel in actual use may be assumed. The fly-wheel of the Atlantic avenue power-house, Brooklyn, which burst about a year ago, was 18 feet in diameter and weighed 20 tons. The other data is lacking, but may be assumed as follows: number of arms, 12; revolutions, 90, giving a peripheral speed of 5,090 feet per minute. With a 20-ton wheel of that diameter, suppose the weight of the rim is 15 tons, and use this alone in calculating the centrifugal force. The rim would have a section of about 175 sq. in. The circumference being 56 feet and there being 12 arms, the length of one span or distance between arms will be 56 inches; hence the greatest bending moment will be $\frac{\textit{centrifugal force} \times 56}{8} = 7 \times$ centrifugal force.

The weight of rim between two arms is 2,500 pounds, hence the centrifugal force of the span will be 62,700 pounds and $7 \times 62{,}700 = 438{,}900$ pounds, equals the maximum bending moment acting at the middle of the span. The maximum shearing stress $= \frac{62{,}700}{2} = 31{,}350$ pounds. Assuming 12,000 pounds as the resistance to shearing per square inch, the total resistance of the rim will be $12{,}000 \times 175 = 2{,}100{,}000$ pounds, or more than 60 times the shearing stress, hence it is evident that though the rim is subjected to shearing stress it is not much of a factor in the forces tending to wreck a wheel.

It is also evident that so long as the rim remains intact it cannot break close to the arms (if the arms are very strong) because the bending moment there is zero and shearing stress is the only one acting, and this, it is shown, is not worthy of consideration.

(To be continued).

Electric Motors in England.

Mr. Rankin Kennedy says that, like continuous current motors which can be used in ordinary continuous circuits, the alternating motor *would not* be much used even if it could, the cost of electrical energy being fatal to the use of motors on supply circuits. He adds that all the alternating motors wanted in Great Britain in a year would not keep one small firm from starvation, even if it secured the contract for the whole of them.

A Millionaire Author Criticised.

A writer of a review in one of our London electrical contemporaries, on John Jacob Astor's "A Journey Through Other Worlds," states that in spite of the preface of puerile platitudes he felt it his duty to read the book through, but he advises his readers not to do likewise unless they are prepared to treat it as a joke, and a weak one at that.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Effect of Cathode Rays on Salts.—A paper of Prof. Goldstein from the "Sitzungsberichte," of the Berlin Academy No. 38, is abstracted in the Lond. "Elec.," Nov. 23; he describes a curious effect which these rays exert on the color of certain salts. If potassium chloride be made to phosphoresce in radiation-tubes it quickly assumes a strong heliotrope shade and eventually becomes bright violet, which on heating becomes blue, and at high temperatures becomes white; the color gradually fades and disappears completely in about a week; in contact with water the salts lose their color at once; in a vacuum or in dry air the deep blue color of lithium chloride lasted for two months without apparent change; the cause of the phenomenon is unknown; chemical decomposition is unlikely. The author believes that during phosphorescence the particles of the salt have been made to take up positions and motions differing from those of the unaltered substances and that a physical modification of the salt has been brought about.

Luminescence of Glass.—Over one hundred years ago Beccaria observed that when vacuum-bulbs were broken in the dark a faint glow of light was produced in the place where the bulb lay, the effect being attributed to the rush of air against the glass walls. In a Physical Society paper abstracted in the English Journals, Nov. 23, Prof. J. J. Thomson concludes, after making numerous experiments that this phenomenon was due to the impact of glass against glass and not to the rush of air against the walls of a broken vessel.

An Electrode Sensitive to Light.—The Lond. "Elec. Rev.," Nov. 23, describes briefly an electrode which is claimed to be much more sensitive than any hitherto made; it was devised by Mr. Luggin and described in the "Zeit. f. Phys. Chem.;" it is made of "a plate of platinum coated with silver bromide and is then duplicated with a similarly coated platinum plate in an aqueos solution of bromide of potassium;" an exposure to diffused daylight was sufficient to cause a rise of potential of 0.5 volt; the rate of rise is not directly proportional to the intensity of the light, and it is lowered by previous exposure to light; continuous and intermittent lights of the same intensity do not produce the same effects and in general the plates do not remain constant in sensitiveness.

Actino-Electric Phenomenon.—A paper describing some researches by Messrs. Marechal & Rigollot is abstracted briefly in "L'Eclairage Elec.," Nov. 10; they also suggest a theory of the earth's magnetism, the earth currents, and the aurora borealis.

Electro-Magnetic Theory.—The long serial by Mr. Heaviside is continued in the Lond. "Elec.," Nov. 23; the present portion being the 59th part. The work of that writer is discussed editorially in the same issue.

Constitution of the Arc.—A French Academy paper by Mr. Thomas, describing some spectroscopic investigations, is published in "L'Elec.," Nov. 17.

MAGNETISM.

Effect of Magnetism on the Dimensions of Wires and Rings.—A Royal Society paper by Mr. Bidwell is reprinted in the Lond. "Elec. Eng.," Nov. 23. He describes the somewhat unexpected effects which were produced by carefully annealing the iron before using it; Joule stated that the elongation is greater in proportion to the softness of the metal, but the present writer shows that this is the reverse of the truth; he finds that after annealing, the maximum increment was less than one-fifth of its former value; and was reached with a magnetic force less than one-half of its former value; after heating it and dropping it into cold water a curve about midway between the others was obtained; in experimenting with rings he found that in one case the smallest current which caused any effect at all produced contraction, and there was no indication of the smallest extension. He concludes that as far as any changes of dimensions are concerned, an iron rod or ring is affected by annealing in very nearly the same manner as by tensile stress, a result which would hardly have been anticipated.

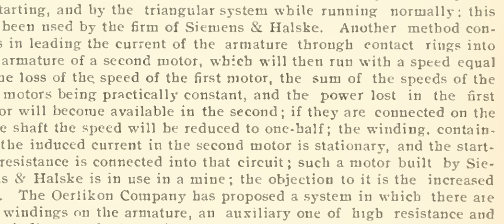
Curious Magnetic Phenomenon.—A phenomenon noticed by Mr. Lloyd is described and illustrated for the Lond. "Elec.," Nov. 23; he shows that when a magnet is broken and then joined or nearly joined again, there is not only a consequent point at the fracture, but there is what he calls an image or ghost of a similar consequent point symmetrically situated with respect to the general shape of the whole magnet, which appears as if it were an optical reflection; tightening the crack seems to make the image or "sympathy crack" more marked, while an air space in the fracture seems to destroy it; fine iron filings and a rather strong field are necessary to bring out the effects; (it appears to be limite to the iron of an electro-magnet); the effect is very remarkable and there seems to be no explanation of it.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Conductivity of Solutions of Salts.—A paper by Mr. Deguisne from the "Weid. Ann." vol. 52, p. 604, is abstracted in "L'Eclairage Elec.," Nov. 10. Dr. Lussana some time ago made the statement that salts have a maximum conductivity in the neighborhood of 4°; the present author describes some recent researches which he made, and from which he concludes that this is not the case.

DYNAMOS AND MOTORS.

Starting Three-Phase Motors.—In a long and interesting paper by Mr. Georges reprinted in the "Elek. Zeit.," Nov. 22; he discusses the starting of shunt and three-phase motors, more particularly the latter. He discusses theoretically the proportioning of the step-by-step resistances. He gives a summary of the numerous devices which have been used and proposed for starting three-phase motors to obviate the employment of sliding contacts on the armature; up to a certain size he shows that the motors may be built without any particular device for starting them, assuming that the source is sufficiently large; to insert the starting resistance in the primary circuit reduces the voltage and the result is similar to inserting it in series with a whole shunt motor, including its magnet windings; it should be remembered that an increased torque requires a greater current than when the resistance is put in circuit with the armature; this method has been applied by the General Electric Company, of Berlin, using choking coils in place of resistances; the same thing can also be accomplished in the motor itself by dividing the stationary windings into two halves, connecting them in series at starting, and in parallel when running normally, or in the case of three-phase motors by connecting the three-phase windings by the star system at starting, and by the triangular system while running normally; this has been used by the firm of Siemens & Halske. Another method consists in leading the current of the armature through contact rings into the armature of a second motor, which will then run with a speed equal to the loss of the speed of the first motor, the sum of the speeds of the two motors being practically constant, and the power lost in the first motor will become available in the second; if they are connected on the same shaft the speed will be reduced to one-half; the winding, containing the induced current in the second motor is stationary, and the starting resistance is connected into that circuit; such a motor built by Siemens & Halske is in use in a mine; the objection to it is the increased cost. The Oerlikon Company has proposed a system in which there are two windings on the armature, an auxiliary one of high resistance and few windings, and the main one of low resistances and many windings, respectively; it involves difficulties on account of the heating, and to overcome these the arrangement shown in Fig. 1, is used by the firm of Siemens & Halske; in this there are two coils in each



FIGS. 1 AND 2.—STARTING THREE-PHASED MOTORS.

branch which are connected so that their E. M. F.'s oppose each other when the motor is started, during which time the outside terminals C_1, C_2, C_3 are not connected with each other; the ampere-windings are also connected so as to oppose each other, the result being that only one-ninth of the ampere-windings are active; for the same torque the loss of speed will therefore be nine times as great as it would be if all the E. M. F.'s act in the same direction; he shows that the heating due to the current will also be reduced to one-ninth; when running normally the three terminals are connected together by a short circuit; a motor thus constructed gave good results; he shows how this may be applied to a step-by-step arrangement for starting. Another method is shown in Fig. 2; the armature contains two equal windings placed at a slight angle

with one another; their E. M. F.'s will be equal, but will differ in phase; if their ends are connected, as shown by single lines, the E. M. F.'s in those connections will be proportional to the lengths of those lines—that is, they will be small; if they are connected as shown by the double lines, the E. M. F.'s will be proportionately greater; if they are all connected together, it will form two independent three-phase windings in which the full E. M. F.'s will exist. In conclusion he states that he does not wish to recommend any one of the above systems as the best, but from a physical standpoint a true resistance in the armature circuit is the best means for starting; in that case one can obtain the full torque without increasing the current above that for full load; or by increasing the current the torque can be increased proportionately but contact rings are then necessary, and to avoid these, it would be preferable in many cases to choose one of the other methods.

Rotatory Field Motors.—Some notes compiled by Prof. S. P. Thompson for the use of his students, explaining in a very clear and simple manner the theory and action of these motors, are published in the Lond. "Elec.," Nov. 23; he discusses the elementary theory, the resultant magnetic flux, the conditions of operation, the starting torque, and the relation between torque and slip; it does not admit of being abstracted; the compiler recommends the article to students and beginners.

E. M. F. and Current Curves of Alternators.—An editorial in the Lond. "Elec. Rev.," Nov. 23, abstracts a paper by Mr. Frith describing some experiments to find out how far the behavior of the machine follows the theory and how many of the Fourier's expressions should be taken into account. The machine was a Wilde alternator, having iron in the armature; the E. M. F. was measured with the usual intermittent contact apparatus, and the magnetization curve of the iron was determined by a flat coil, which could be suddenly withdrawn from between the coils and the armature. The curves show that the self-induction of the armature decreased with the increase of the magnetization of the iron in the cores. The regularities in the curve died out when power was taken from the machine, and it becomes nearly straight at first and then approaches the sine curve; the surging of the lines of force of the field magnets was also examined; the motion of the magnetic field accounted in a large degree for the deviation from simple sine curves; when the armature contains iron he concludes that at least three terms of the Fourier's expression must be considered; especially the third, the second being generally comparatively small; the machine had a large armature reaction, and the deformations were somewhat exaggerated by the primitive design of the machine.

Motors and Dynamos.—In a continuation of the description of the electrical exhibits at the Lyons Exhibition, Mr. Jacquin in "L'Eclairage Elec.," Nov. 3, describes with illustrations some of the machines, including a bi-phase synchronous and a non-synchronous motor.

TRANSFORMERS.

Principles of Transformer Design.—The article by Mr. Still is concluded in the Lond. "Elec.," Nov. 23, and treats of the design and manufacture of transformers; the copper and iron losses are discussed and formulas are given; the eddy current losses in the iron should be very small; they vary as the squares of the induction and frequency and thickness of the plates; the following formula gives the watts by eddy-currents lost per pound of well-insulated iron plates,

$$\frac{1.4}{10^{10}}\, t^2\, n^2\, \mathfrak{B}^2$$

in which t is the thickness of the plates, n the frequency and $\mathfrak{B}$ the maximum induction in lines per square inch. For the hysteresis losses in watts per pound for a good quality of iron he gives the following formula:

$$0.88\; n\; \mathfrak{B}^{1.55}\; 10^{-9};$$

to obtain the watts loss per cubic inch, multiply 0.28; for 16,000 lines per square inch and a frequency of 100, the hysteresis losses vary between one-quarter of a watt and half a watt or even more, per pound. A table is given showing the losses per pound, with a frequency of 80. Regarding the thickness of the plates he states that there is no advantage in making it less than 0.013 or 0.012 inch; (in his calculations he generally uses 0.014). Regarding the insulation between the plates, he states that for paper insulation the ratio between the space occupied by the iron and the total space is about 0.85, and with a thin coat of varnish instead, it may be as much as 0.9 The most economical load for a transformer is that which makes the copper losses equal to the iron losses; to prevent excessive heating, a cooling surface of about 4 sq. in. per watt lost in the transformer should be allowed; it is a mistake to reduce the losses beyond certain limits unless it can be done by using better iron; in a good transformer for lighting purposes with a maximum "drop" of 2 per cent., the losses should be about 70 watts in the iron and 60 in the copper for a 3 kilowatt transformer, and 100 watts in the iron and 110 in the copper for a 6 kilowatt transformer; he claims that there is no great advantage in reducing the reluctance of the air-gap very much, and that an appreciable air-gap does not necessarily imply a loss of efficiency. He discusses at some length the calculation of a transformer from another of the same type, but of different capacity. In the summary of the formulas he gives the following for the magnetizing current in good closed magnetic circuit transformers,

$$\text{Magnetizing current} = \frac{\text{total watts lost in iron}}{\text{primary E. M. F.}} \times 1.4$$

in which the factor 1.4 is the reciprocal of the power factor.

ARC AND INCANDESCENT LIGHTS.

Researches with the Electric Arc.—The conclusion of the paper by Dr. Sahulka, the first part of which was abstracted in the Digest, Dec. 1, is published in the "Zeit. fuer. Elek.," Nov. 15. He describes measurements made to determine the voltage between the electrodes and the arc (referring apparently to an alternating current arc between iron and carbon); a small carbon rod was introduced into the arc as a terminal; the arc was found to be positive as compared with both of the electrodes; in one case the voltage of the whole arc was 28.3, that between the arc and the carbon was 4.6, and that between the arc and the iron was 32.8 volts; that of the whole arc was, as a rule, equal to the difference (the algebraic sum) between the other two, referring to those between the arc and each of the electrodes; the measurements were always made after the small carbon point, used as a terminal, was at a white heat. He describes some very curious results, some of which cannot be explained; for instance, different results were obtained when a torsion galvanometer was used than when a simple galvanometer was used; the results were also different when the voltages were measured separately, than when measured together, and in some cases the voltage changed signs when measured with one instead of two instruments. A curious result was obtained when it was attempted to compensate the continuous current generated in the arc; it was done by means of accumulators, but it was not possible to neutralize the continuous currents, as the arc then became small and was extinguished; the continuous voltage became smaller the more nearly this continuous current was compensated. It was also shown, by means of a telephone in series with a condenser and connected to the two electrodes, that the arc consists of disruptive charges; when no arc existed, a certain note was heard corresponding to the frequency, but when the arc was formed the note became louder and higher in pitch, caused, it is thought, by disruptive discharges; if the arc was formed with a continuous current a loud hissing noise was heard. He then describes some researches with the alternating current arc between carbon electrodes; when the arc was vertical the upper carbon was always negative as compared with the lower and showed a continuous voltage of about 2.8 volts; when the arc was horizontal no such continuous voltage existed and there was no continuous current in the circuit; when the arc was horizontal a continuous voltage existed between the arc and the electrodes, the arc being negative to both of them, the voltage being about 7; if a shunt circuit was made between the arc and one of the electrodes a continuous current flowed through it. In conclusion he makes some deductions and states that these experiments show that there is a true counter E. M. F., generated in the alternating current arc, and it may, therefore, be inferred that it exists also in the continuous current arc. In the discussion which followed, Prof. Lecher remarked that he had noticed that the needle of a tangent galvanometer was deflected by an alternating current and that it is only with a specially constructed galvanometer that the existance of a continuous current can be proved.

ELECTRIC RAILWAYS.

Steep-Grade Traction.—An Institution paper by Mr. Preller on electrical steep grade crossings in Europe is reprinted in the Lond. "Elec. Eng.," Nov. 23. He gives a synopsis of what has been done in this direction in Europe, more particularly in Switzerland, compares results and draws conclusions; he shows the advantages of cable traction on mountain roads when the cable is operated by electrical motors; he finds that the cost of construction is about 40 per cent less and the working expenses are only about one-half as great. Regarding the cost of operating adhesion or rack railways by steam and by electricity, he concludes that irrespective of the immensely greater elasticity of the service and consequently the far more rapid development of the traffic, electrical working ensures an economy of at least 50 per cent. compared with steam. Among his general conclusions he states that vertical high-speed engines suitable for direct driving generally work uneconomically on account of the rapid variations of the load; the first cost of a hydro-electric installation often exceeds that of a steam plant, especially with low-pressure turbines; high pressure turbines are always preferable and more economical; where cheap hydraulic power is not available within a distance of about four miles, gas manufactured on the spot is much more economical than steam. Regarding the trolley, he believes that if the lines contain many and short curves, the sliding contact wire as used by Siemens & Halske is far preferable; regarding the subject of continuous and alternating currents for traction, he believes that the latter is destined to supplant the former and that it will insure a saving of about 30 per cent. in the weight of dynamos and motors, irrespective of the saving in copper, and will thus considerably simplify and cheapen electrical installations.

Street Railways.—The "Zeit. fuer Elek.," Nov. 15, abstracts a recent paper of Mr. van Vloten which contains some interesting statistics regarding the electrical lines in Europe at the end of 1893; the total mileage of roads in operation was 186, of which a third was in Germany; there were about 105 miles under construction; 27 out of 44 are operated by the trolley system.

Light Railways.—The discussion of the subject of light railways in England is continued in the Lond. "Elec.," Nov. 23.

Rail Bond.—A bond devised by Mr. Robinson is illustrated in the Lond "Elec. Eng." and "Elec. Rev.," Nov. 23. The terminals consist of short wrought iron tubes expanded into the webs of the rails in the

same way in which boiler tubes are secured; the ends of the copper wire are then wound around these projecting tubes.

Submarine Boats.—The English journals of Nov. 23 give a few further facts about a recent trial of the boat "Gustave Zede." It is 113 ft. long and displaces about 226 tons; the speed attained was from five to eight knots per hour with 300 accumulators on board; although the boat was not submerged for a single moment, the acid vapors from the batteries caused great discomfort to those on board; unless the latter feature can be remedied it will be impossible to submerge it for more than a few moments at a time.

Leads for Railway Circuits—See an abstract under "Wires, Wiring and Conduits."

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Alternating Current Motor System.—An article by Mr. Imhoff is published in the "Elec. Zeit," Nov. 22; he claims to have invented the system in the summer of 1893 and states that it admits of regulation and of the combined use for light and power. It consists in supplying a second current from the station, which is to be used only for starting the motors; a small secondary dynamo is coupled directly to the main machine and generates a current differing by 90° from the main current; this requires the use of one or two extra leads which, however, are run only to installations containing motors, and as they are used only for starting the motors, the leads may be quite small; this will enable motors to start like three-phase motors with a large starting torque; when the system contains secondary stations then the auxiliary current may be generated there instead of at the main station.

Theory and Practice in Electrical Engineering—In an article by Mr. Kennedy in the Lond. "Elec. Rev.," Nov. 23, he described the agreement and disagreement between theory and practice. Among other things he states that there is not much superiority in the three-wire system over the older multiple series system; in comparing the alternating and continuous current systems he shows the absurdity of using the former for short distance transmission and cites several cities in which the alternating current system was used although distances were not great; to abandon parallel running is a mistake both in theory and in practice unless there is storage to fall back upon; if alternators are run separately duplicate machines must be provided and kept going ready to switch on at any moment; the disadvantages of alternating currents have been multiplied ten-fold by what he calls the insane practice of adopting various frequencies.

Lighting Installations.—The discussion of Mr. Henderson's paper mentioned in the Digest last week, is published in the Lond. "Elec. Rev.," Nov. 23.

WIRES, WIRING AND CONDUITS.

Inductance in Aerial Lines.—The serial by Prof. Blondel (see Digest, Dec. 1) is continued in "L'Eclairage Elec.," Nov. 10. He compares the different systems in regard to the inductance on the lines and gives an interesting table showing the relative weight of copper, the ohmic resistances, the loss of energy and the diameter for all the different systems under different assumptions; he makes comparisons, gives a number of simple formulas, and applies them in making deductions from the famous Lauffen-Frankfort transmission plant; he also discusses the different dispositions of the four wires on the lines, to furnish the inductance. Among other things he states that the figure given by Mr. Scott in a recent paper on polyphase transmission is below the correct value—referring to the statement that the inductions of a triphase line is reduced to 0.54 per cent. of that of a monophase line. (As the discussion of this subject involves many complications it might be doing injustice to the author to abstract particular results without giving all the necessary qualifications; the discussion appears to be a very complete one and may be recommended to those specially interested in this subject).

Leads for Railway Circuits.—A paper by Mr. Dierman is abstracted at some length in "L'Eclairage Elec," Nov. 10. He describes in detail a method for calculating the leads and feeders, which is partially graphical and which he believes has not yet been used. Having given the profile of the road, the position of the cars, the speed and similar data, he constructs a diagram giving the force of traction as ordinates on a base line corresponding to the base line of the profile from a diagram giving the efficiency of the motor at various speeds; he then converts these ordinates into those representing the current required at every point along the route; from these he then calculates the leads and feeders, calling attention to the fact the loss in the line is proportional to the square of the current and that therefore it is not correct to base any calculations on the mean current strength; but it should be based on the square root of the mean of the squares; he also states that the general method based on a maximum loss requires much more copper than is really necessary. An example is worked out.

Wiring Regulations.—Those adopted in Manchester are published in the Lond. "Elec. Eng.," Nov. 23.

TELEGRAHY, TELEPHONY AND SIGNALS.

Switchboards for Telephone Stations.—A new arrangement by Mr. Engelmann is described and illustrated in the "Elect. Zeit.," Nov. 22. It appears to be a simplification and can be adapted to an almost unlimited number of subscribers besides being quite a little cheaper; it appears to differ but little from that used in Buffalo, N. Y.

Telephone Building.—A description of the new building of the National Telephone Co. is given in the Lond. "Elec. Rev.," Nov. 23.

Sub-Marine Telegraph.—An article by Mr. Marcillac is begun in "L'Eclairage Elec.," Nov. 10. He gives a review of the subject beginning with the original Morse system.

ELECTRO-CHEMISTRY.

Extracting Gold.—The Lond. "Elec. Rev.," Nov. 16, contains an article by Mr. Andreoli on cyanide and electrolytic cyanide solutions, which is of special interest in connection with a recent lawsuit; he shows that the use of cyanide solutions has been known for a long time and replies to a number of statements to the contrary. "L'Eclairage Elec.," Nov. 3, contains the first part of an article of a similar nature by the same author, in which he discusses also the application of electricity in the process; both articles contain a large number of interesting references to previous publications.

Electro-Deposition of Gold.—Mr. Weightman, in the Lond. "Elec. Rev.," Nov. 23, discusses some of the points brought up by Mr. Andreoli (see Digest, Dec. 1 and 8). He calls attention to the fact that as the solution gets weaker it becomes more difficult to remove the last traces of the gold and he suggests allowing the last traces to remain there and using the solution over again, thus always leaving a small quantity of gold as an essential part of the working solution; he shows the importance of circulation, especially with weak solutions. He believes the questions of anodes is not as important as is supposed; many substances will answer, especially iron, which will not form Prussian blue unless allowed to oxidize; he suggests that the disintegration of carbon is very slow; the cathode surface should be as great as possible while the size of the anode makes no difference except in the voltage; the chief objection to using a great current is the large amount of the cyanide which it would decompose; he quotes Mr. Gernet as saying that a better result is obtained by doubling the plates than by increasing the current tenfold.

Local Action in Accumulators.—The subject is discussed in a general way by Mr. Darrieus in Lond. "Elec.," Nov. 17. Among other data he gives the following figures: Perioxide of lead and a grid of antimony lead give an E. M. F. of 1.40 volts; he shows by the following experiments that the active material is perioxide of lead, contrary to what is supposed; a small capsule of platinum was filled first with perioxide prepared by a chemical process and then with electrolytic peroxide in each case measuring the E. M. F. with the same negative plate and obtained 2.05 volts in each case; a grid of antimony lead and a plate of spongy lead, both emerged in sulphuric acid gave 0.52 volt.

Pocket Accumulator.—The results of some tests of a dry Fitz-Gerald accumulator are given in the Lond. "Elec. Rev.," No. 23; it states that they indicate the possibility of great improvement in the construction of accumulators for traction and other purposes (the data given is so scant and incomplete that it is of little use); neither the voltage nor the capacity is given; the figures given make it impossible to compare it with others; the results are claimed to be remarkable and unprecedented.

Gas Battery.—A translation of the paper asbtracted in the Digest last week is published with the curves in the Lond. "Elec.," Nov. 23.

Electricity Direct from Coal.—An abstract of the paper of Dr. Borchers, mentioned in the Digest last week, is published in the Lond. "Elec. Rev.," Nov. 23, including the illustrations. A reprint of the whole article with illustrations is also published in the "Elek. Zeit.," Nov. 22.

Chemical Analysis.—The Vortmann process for estimating the halogens by means of electrolysis is briefly described in the Lond. "Elec. Rev.," Nov. 23.

Polarization.—An article from the "Weid. Ann.," Vol. 52, p. 191, by M. des Coudres is abstracted in "L'Eclairage Elec.," Nov. 10.

MISCELLANEOUS.

Electrical Plow.— A complete system for operating an electrical plow is described and illustrated in the "Elek. Echo," Nov. 17, including estimates of the cost of operation, which appear to show that it is about half the cost of operating a steam plow; the source of power is a trans portable boiler and engine, such as is used for agricultural purposes, and the plow is drawn by the winding up of a chain cable anchored at each end; the plow contains four shoes pointing in one direction and four pointing in the other, so arranged that the plow is drawn first in one direction and then in the other without requiring to be turned; the plant appears to have been in actual operation and is not a mere suggestion.

Electrically Operated Valves for Steam and Water Pipes.—A system is described and illustrated by Mr. Berg in the "Elec. Zeit.," Nov. 22.

Substitute for Guttapercha.—According to the "Elec Tec.," Nov. 15, Mr. Hutchinson has discovered a method for combining India rubber with guttapercha, the combination forming a much cheaper compound; it consists of 50 parts of guttapercha, 30 parts of India rubber and 20 parts of "Lanichol," which is a substance obtained as a by-product in

the preparation of wool and is obtained from the oil in the wool, and known by the name of "cholecaterin;" the mixture is heated to the boiling point of water, it has all the properties of guttapercha and in addition it is better as it does not oxidize.

Carborundum.—The Lond. "Elec. Rev.," Nov. 23, states that a company in Frankfort, Germany, have recently produced a new product which they call carbonit-carborundum, and which is said to excel carborundum in durability without any loss of sharpness; it can be used in larger grains and is cheaper.

Electrolysis in Urethral Stricture.—An article by Dr. Newman, of New York, describing the treatment, which appears to have been a very successful one, is published in the Lond. "Elec. Rev.," Nov. 23.

New Books.

ELECTRIC LAMPS AND ELECTRIC LIGHTING. A Course of Four Lectures on Electrical Illumination Delivered at the Royal Institution of Great Britain. By J. A. Fleming, M. A., D. Sc., F. R. S. New York: The D. Van Nostrand Co.; London: *The Electrician* Printing and Publishing Company, Ltd. 228 pages, 93 illustrations. Price, $3.00.

This handsomely printed and bound volume contains four lectures on "Electric Illumination," delivered by Dr. Fleming at the Royal Institution, London. The author in the preface states that the aim was originally only to offer to a general audience such non-technical explanations of the physical effects and problems concerned in the modern applications of electricity for illuminating purposes as might serve to further an intelligent interest in the subject and perhaps pave the way for a more serious study of it, stress being laid upon principles rather than upon details.

The first lecture deals with the elementary principles of electricity, light and photometry, the two latter being very satisfactorily considered and in terms easily understood by the non-technical reader. The second lecture takes up the incandescent lamp, and in the 75 pages included is given a great amount of information in regard to the principles upon which the lamp is constructed, its various forms, the relations, illustrated by curves, between the voltage, efficiency, life and candle power, the ageing of lamps, their luminous efficiency, etc. The lecture concludes with a consideration of the manner in which incandescent lamps can be employed in order to produce the best illuminating effect, and with a very full discussion of the "Edison effect."

The third lecture is devoted to arc lamps and the physical properties of the arc, including the distribution of potential and its temperature. The principles of arc lamp mechanism are explained and many points in practical arc lighting considered. This and the preceding division of the book form by far the best non-technical treatise we know of on the incandescent and arc lamp and the accuracy and extent of the information are such as to make it welcome to the technical reader.

Electrical distribution is the title of the concluding lecture, though the greater part is devoted to explanations of the dynamo and transformer, including an exposition of the principles of the dynamic generation of electricity. Several types of machines are illustrated and a number of illustrations, including that of Tivoli near Rome, are well described.

As a work for non-technical readers who wish to attain correct ideas in regard to electric lamps and electric lighting this is perhaps the best book now in print. It will also be found useful by the student and electrician and even the educated engineer will find gathered in it a considerable amount of information that otherwise he would have to seek for in scattered periodical literature.

ELECTRIC LIGHTING PLANTS. Their Cost and Operation. By W. J. Buckley. Chicago: William Johnston Printing Company. 279 pages, 32 illustrations, 19 plates. Price, $2.

The preface states that the writer of this useful little book is "neither electrician, engineer nor expert, but a salesman"—identified with one of the large electrical manufacturing companies since 1884. While we find in the pages occasional evidence of the correctness of this statement, yet the work is one that contains a great deal of useful technical information, and the remarks of the writer directing prospective purchasers' attention to the points to be observed in considering the details of an installation are well worthy of respectful attention. The author frankly avows that, having been identified for years with a particular electrical manufacturing company, he has "in a noble effort to deserve his salary," mentioned no other lighting apparatus but that made by his company; nevertheless, having been thus warned, the reader will doubtless be surprised at the modest advantage taken in this respect.

The book contains a large number of tables of the cost of the various parts that go to make up a complete lighting equipment, including several estimates for complete plants. In addition there are numerous other tables of data, the character of the work, in fact, being to a great extent similar to that of pocket manuals. The "Instructions for Employees" of Mr. J. I. Ayer are included, as well as the insurance rules of the Underwriters International Electric Association, and the similar compilation of the National Electric Light Association.

While the book is largely a compilation, and the matter is rather poorly arranged, it will nevertheless prove a useful work to the many who care for practical information uncomplicated with references to theory and authorities.

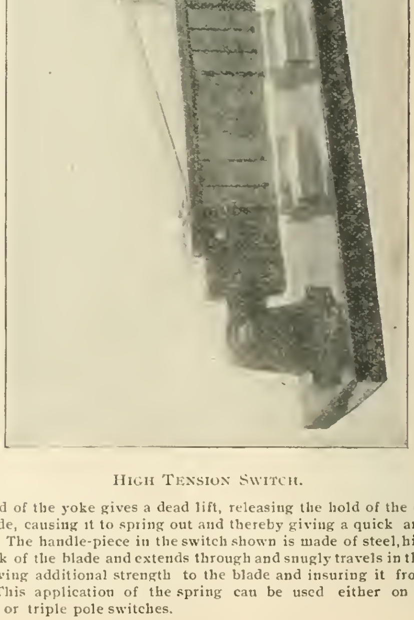
ELECTRIC RAILWAY MOTORS. Their Construction, Operation and Maintenance. By Nelson W. Perry, E. M. New York: The Street Railway Gazette Company. 238 pages, 60 illustrations Price, $1.00.

This little book admirably fulfills its object, which, as stated in the preface, is to provide for motormen an intelligent elementary exposition of the principles upon which are founded the apparatus they are called upon to handle, and give instruction in regard to the care of street railway motors and the detection, remedy and prevention of their faults. The electrical principles upon which the theory of the motor and its operation is based are logically and intelligently developed from the simplest conceptions and, with reference to home-made experimental apparatus, cheaply and easily made. Somewhat more than half of the book is devoted to the explanation and development of theory and the remainder to descriptions of various systems and practical instructions, though the former are rather meagre. The final chapters are of particular value as they contain a compilation from many sources, with additions by the author, of specific directions for the management of motors, the remedy of faults, directions to motor men, instructions for inspectors and superintendents, etc.

The work is a vast improvement on the style of books usually written for practical men, not only in being scientifically correct, but from the conscientious endeavor apparent throughout to render intelligible to the reader every phase of the subject, notwithstanding the inherent difficulty, coming within the scope of the book. As a rule, books written for this class of readers, particularly if written by one of them, are weak in both of these particulars and frequently offensive through a patronizing air entirely absent in the present instance. On the other hand, a noticeable defect is a diffuseness which at times is excessive, as, for example, where almost six pages are required to relate a little anecdote and point the moral.

High Tension Switch.

The accompanying cut illustrates a switch for high tension currents and railway work, recently brought out by J. Grant High & Company, 123 N. Third street, Philadelphia. In getting out this switch the inventor, Mr. George T. Eyanson, treasurer for the above firm, had in mind the principle that in a quick break switch the contact between the blade and clips should remain intact until by lifting the handle all the resiliancy in the spring is stored up; the handle-piece then coming in contact with



HIGH TENSION SWITCH.

the head of the yoke gives a dead lift, releasing the hold of the clips on the blade, causing it to spring out and thereby giving a quick and long break. The handle-piece in the switch shown is made of steel, hinged in the back of the blade and extends through and snugly travels in the yoke, thus giving additional strength to the blade and insuring it from damages. This application of the spring can be used either on single, double or triple pole switches.

Copper Fuses.

We print herewith a table giving diameters of copper fuses for currents to 1,000 amperes, compiled by Mr. Eustace Oxley and sold, well-printed on a large sheet, by H. E. Robinson, 61 West 133d street, New

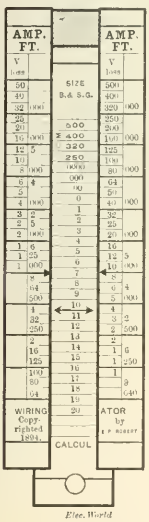
Current in Amperes	Diameter in Inches	Current in Amperes	Diameter in Inches	Current in Amperes	Diameter in Inches	Current in Amperes	Diameter in Inches	Current in Amperes	Diameter in Inches	Current in Amperes	Diameter in Inches
1	.0021	51	.0292	101	.0460	155	.0612	405	.1161	810	.1843
2	.0034	52	.0295	102	.0463	160	.0626	410	.1170	820	.1858
3	.0044	53	.0300	103	.0466	165	.0638	415	.1180	830	.1873
4	.0053	54	.0303	104	.0469	170	.0651	420	.1190	840	.1888
5	.0062	55	0307	106	.0472	175	.0663	425	.1199	850	.1903
6	.0070	56	0310	106	.0475	180	.0676	430	.1208	860	.1917
7	.0077	57	.0314	107	.0478	185	.0688	435	.1217	870	.1932
8	.0085	58	.0318	108	.0481	190	.0701	440	.1227	880	.1947
9	.0092	59	.0321	199	.0484	195	.0713	445	.1238	890	.1962
10	.0098	60	.0325	110	.0487	200	.0725	450	.1246	900	.1976
11	.0105	61	.0329	111	.0490	205	.0737	455	.1254	910	.1991
12	.0111	62	.0332	112	.0493	210	.0749	480	.1284	920	.2005
13	.0117	63	.0336	113	.0496	215	.0761	465	.1273	930	.2020
14	.0123	64	.0339	114	.0498	220	.0773	470	.1261	940	.2034
15	.0129	65	.0343	115	.0501	225	.0784	475	.1291	950	.2049
16	.0135	66	.0346	116	.0504	230	.0796	480	.1300	960	.2064
17	.0140	67	0350	117	.0507	235	.0807	485	.1308	970	.2078
18	0146	68	.0353	118	.0510	240	.0819	490	.1318	980	.2092
19	.0151	69	.0357	119	.0513	245	.0830	495	.1328	990	.2106
20	.0156	70	.0360	120	.0516	250	.0841	600	.1338	1000	.2120
21	.0161	71	.0364	121	.0518	255	.0853	610	.1354		
22	.0166	72	.0367	122	.0522	260	.0864	620	.1371		
23	.0171	73	.0370	123	.0524	265	.0875	530	.1389		
24	.0176	74	.0374	124	.0527	270	.0885	640	.1406		
25	.0181	75	.0377	125	.0530	275	.0897	650	.1423		
26	.0188	76	.0380	126	.0533	280	.0908	560	.1441		
27	.0191	77	.0384	127	.0536	285	.0918	570	.1457		
28	.0195	78	.0387	128	.0539	290	.0929	580	.1474		
29	.0200	79	.0390	129	.0541	295	.0940	690	.1491		
30	.0205	80	0394	130	.0544	300	.0950	600	.1509		
31	.0209	81	.0397	131	.0547	305	.0961	610	.1525		
32	.0214	82	.0400	132	.0550	310	.0971	620	.1542		
33	.0218	83	.0403	133	.0552	315	0982	630	.1558		
34	.0222	84	.0407	134	.0555	320	.0992	640	.1576		
35	.0227	85	.0410	135	0558	325	.1002	650	1592		
36	.0231	86	.0413	136	.0561	330	.1013	660	.1607		
37	.0235	87	.0416	137	.0563	335	1023	670	.1624		
38	.0240	88	.0419	138	.0566	340	.1033	680	.1640		
39	.0244	89	.0423	139	.0569	345	.1043	690	.1658		
40	.0248	90	.0426	140	.0572	350	.1053	700	1671		
41	.0252	91	.0429	141	.0574	355	.1063	710	1688		
42	.0256	92	.0432	142	.0577	360	.1073	720	.1703		
43	.0260	93	.0435	143	.0580	365	.1082	730	.1719		
44	.0264	94	.0438	144	.0582	370	.1092	740	.1735		
45	.0268	95	.0441	145	.0585	375	.1103	750	.1750		
46	.0272	96	.0444	146	.0588	380	.1113	760	.1766		
47	.0276	97	.0448	147	.0591	385	1122	770	.1781		
48	.0280	98	.0451	148	.0593	390	.1132	780	.1797		
49	0284	99	.0454	149	.0596	395	.1141	790	.1812		
50	0268	100	.0457	150	.0598	400	1151	800	.1827		

DIAMETERS OF COPPER FUSES.

York. The table is computed from the law that the fusing point varies as the square-root of the cube of the diameter, using a constant determined by Preece in his classical experiments.

Slide Rule Wire Calculator.

The slide rule wire calculating scale we illustrate, the invention of Prof. E. P. Roberts, of the Correspondence School



SLIDE RULE WIRE CALCULATOR.

of Technology, Cleveland, O., is based on the following principles: 1st. No. 10 copper wire measures 1 ohm per 1,000 feet, and is 0.1 inch in diameter, and, therefore, is of 10,000 circular mils cross section. 2d. Each third size larger doubles in area, halving the resistance. 3d. Each size is 0.8 the resistance of the next larger or 1.25 of the next smaller.

From (1) it follows that 1,000 ampere-feet of No. 10 wire must have one volt drop with one ampere. This is noted in the left hand column of the scale. When the arrows are in line it will be seen that No. 10 wire has 1,000 in the line on the left. This 1,000 represents ampere-feet. The first figure is separated from the others by a vertical line. The portion to the left of the line represents volts; thus 1,000 ampere feet has one volt loss for No. 10 wire. In the right hand column the figures are ten times those on the left; they likewise represent both ampere-feet and volts loss, and, when the arrows are in line, they also represent circular mils.

From the above it will be seen that the scale is founded on a law which, when fully comprehended, makes its use very simple and reliable. To find the size wire for any given number of volts loss and ampere-feet, all that is necessary is to place the arrows on the slide opposite the volts loss, and note the size wire in line with the ampere-feet. To find the drop for any given size, reverse the above.

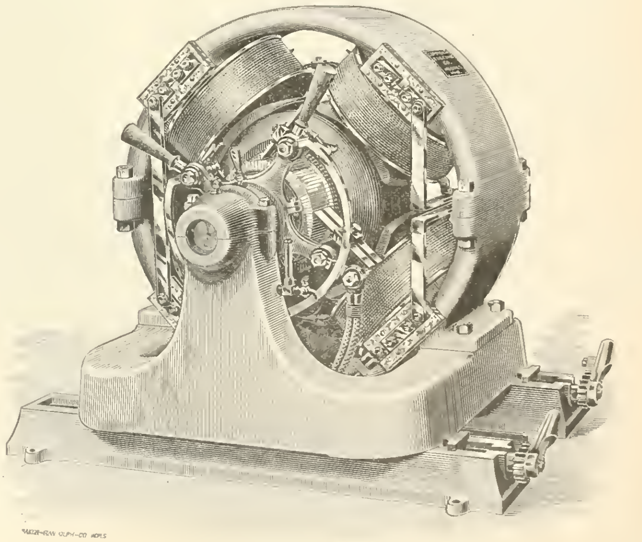
As areas are obtainable it is possible to compare wire of different sizes and obtain the equivalent value of a cable, etc. On the back of the scale is printed the carrying capacity according to the insurance rules, and also examples of use. The scale is enclosed in a leather case made to fit the vest pocket, and is accompanied by a leaflet of examples of use more elaborated than is possible on the back of the scale.

Multipolar Generators and Motors.

A new line of slow speed, multipolar generators and motors has recently been placed on the market by the Commercial Electric Company of Indianapolis, which, as will be seen from the cut, are exceedingly compact and neat in appearance. Their slow speed, the small floor space required and their high efficiency, make them especially desirable machines for both lighting and power.

The armatures, which are of the smooth core, Gramme ring type, are made of a special grade of iron having a minimum hysteretic loss, and the absence of teeth entirely does away with eddy currents in the pole pieces and the sparking due to high self induction. The armatures are thoroughly ventilated, and this, together with the large cross section of the conductors and the freedom from core loss obtained by the above construction, results in a very low rise in temperature. Each coil of the armature is entirely independent, and if damaged can be renewed without disturbing any of the others. The commutator is made of the hardest copper and clear sheet mica insulation and the great useful depth of the segments permits of turning it down many times without necessitating renewal.

The magnet frame is of cast steel of the highest permeability and is mounted on a broad cast iron base, which carries the bearings. The bearings are of the spherical, self-aligning type, and are provided with

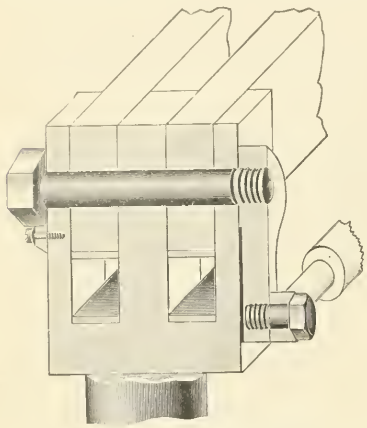


COMMERCIAL MULTIPOLAR MACHINE.

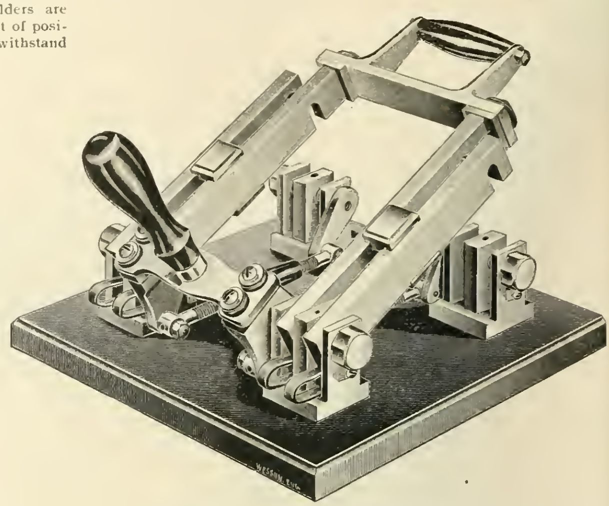
oiling rings which dip into an oil reservoir of large capacity, so that frequent renewals of the oil are avoided. The bearings have phosphor bronze linings, with a large bearing surface. The pulleys are of large diameter and have ample belt surface, so that the full power of the

machine may be transmitted with but light pressure on the bearings due to belt pull.

The field coils have a large radiating surface, and thus run at a very low temperature. They are easily removed and the series coils are placed at one end of the spool, so that either the series or shunt coil can be repaired without disturbing the other. The brush holders are mounted upon a rocker arm and have independent adjustment of position and tension. The insulation is of the highest grade and will withstand a pressure of 5,000 volts between the windings and the frame.



Bolted Contact.



Bolted Contact Switch.

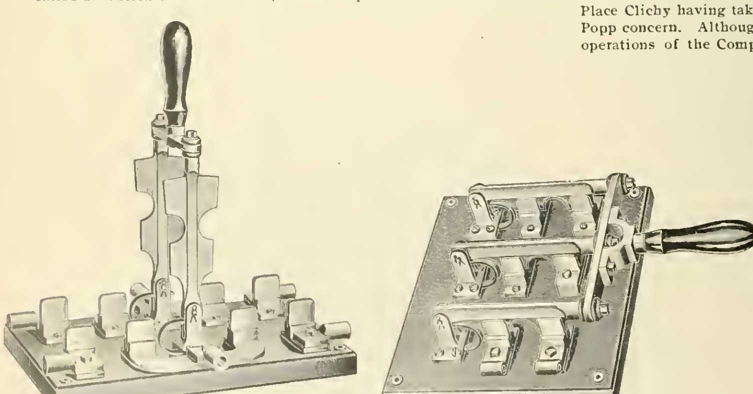
These machines are built in sizes from 40 to 100-kw., and are adapted for belt driving or direct connection. Their ability to withstand the sudden fluctuations of lead and the severe temporary over loads peculiar to street railway work make them especially valuable for that purpose.

New Switches.

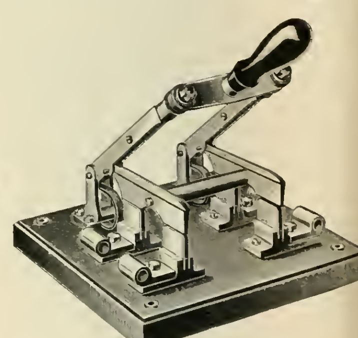
We illustrate herewith several new forms of switches manufactured by Linton & Southwick, Worcester, Mass. One of these, shown above, is called a "bolted contact" switch, and is adapted for use in connection with currents running into the hundreds or thousands of amperes. There is a well recognized difficulty in the use of heavy current switches due to the necessity of having large contact surfaces and considerable pressure on those surfaces, thus causing excessive friction and requiring the exercise of considerable power to open and close them. In the switch illustrated, the contact bars or blades merely have a snug fit in the jaws connecting with the circuit, which, after making contact, are strongly pressed together by means of a crank-shaped disc or nut and a screw thread on a bolt passing transversely through the jaws and operated by a supplemental handle. When it is desired to open the switch, the supplemental handle is moved so as to release the tension on the jaws, and the switch is then easily opened. The sketch shows the details of construction in section.

A quick-break switch is also shown, in which the contact blade is in two sections. In breaking contact the opening of the upper section places the lower one under the tension of a spring of special form, and when the friction of the contact surfaces is overcome this section flies up to the other, making an instantaneous break of considerable width, and preventing arcing.

A form of spring employed for holding the blades of their switches in position is employed, shown in two cuts below, which possesses several advantages in strength, simplicity and special temper.



Double-Pole Double-Throw and Three-Pole Single-Throw Switches, Showing Spring.



Quick-Break Switch.

Electric Lighting in Paris.

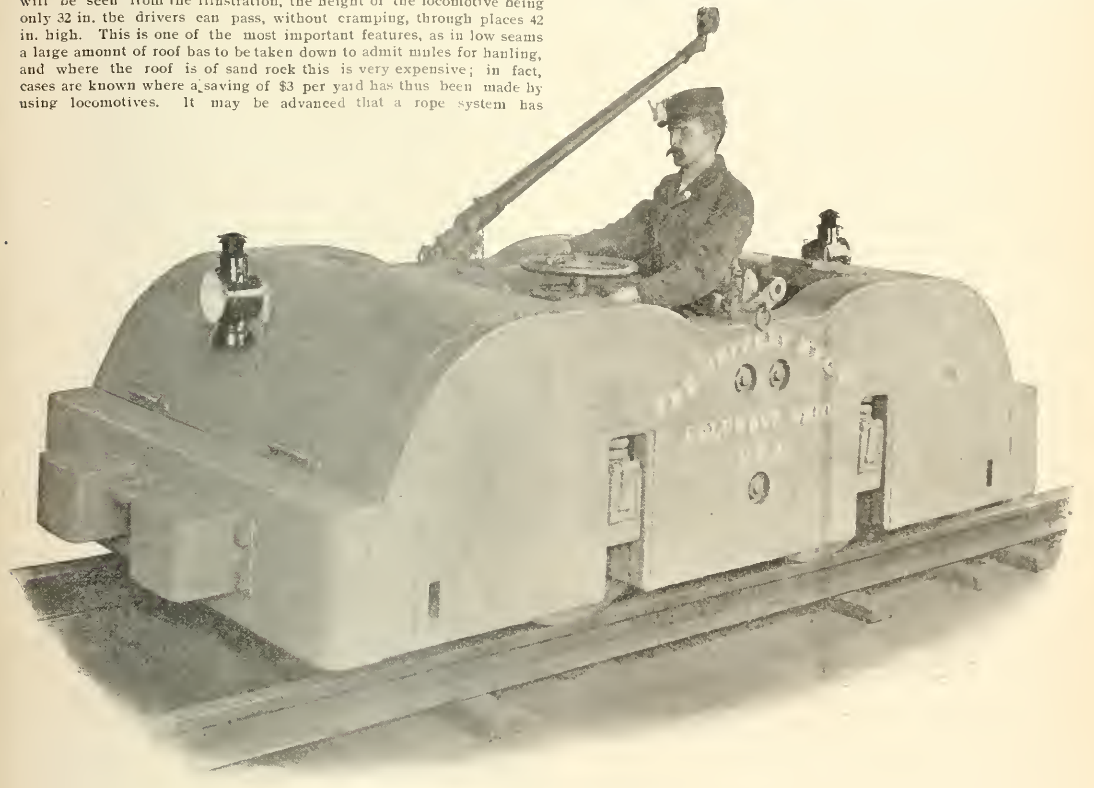
The Paris correspondent of the London *Electrician*, reports that the Municipal Council has had a proposal brought before it to withdraw from the Compagnie Parisienne de l'Air Comprimè (the Popp system) its right to lay cables under the public way. This is the illogical outcome of several gentlemen on the Board of the Société du Secteur de la Place Clichy having taken up analogous positions on the Board of the Popp concern. Although in possession of the finest district in Paris, the operations of the Compagnie Parisienne de l'Air Comprimè show a deficit of some 28 million francs. The financial supporters of this disastrous enterprise are determined at all costs to get out of this rut, and they have come to an agreement with the Société de la Place Clichy to undertake the transformation of the Popp system into a five-wire network. This being so, the Municipal Council immediately thought that the Popp Company's area was going to be annexed by the Société de Clichy, but if the statements of the two boards are to be credited, the two concerns will remain autonomous. For the first six months of 1894, the Compagnie Parisienne has improved its position, thanks not to increased receipts, but to reduced expenses. The profit and loss account shows a profit of 100,845 francs against a loss of 157,000 francs for the first six months of 1893; the working expenses exhibiting a reduction of 100,000 francs. The final net result, however, thanks to the financial burdens that weight the undertaking, is a loss of no less than 584,000 francs.

Electric Haulage.

The electric locomotive we illustrate has recently been brought out by The Jeffery Manufacturing Company, of Columbus, O., and is claimed to possess all the requirements that have been shown to be necessary during the long experience of this company in the designing and manufacture of mining apparatus. The locomotive is compact, strong, simple in arrangement and accessible, with very few parts that can get out of order, thus reducing the liability to delays and shut downs, which has been the great trouble with many locomotives designed in the past. One of the advantages obtained by the method of construction used is the interchangeability of parts on the locomotive, everything being in duplicate, or in other words, there are two locomotives combined in one.

This locomotive is built in three sizes, 40, 60, and 80-hp, the latter size being the one illustrated. The weight is 19,000 lbs.; length over all, 10 ft. 6 in.; width, 64 in. for a 42-in. gauge; height from rail, 32 in. It can run on a 30-lb. rail without excessive wear on the track, as 80 per cent. of the weight is supported on good flexible springs, making it impossible to hammer the track, as is the case where no springs are used or where connecting rods are used between the axles. The comparative small dimensions enable it to be used where any ordinary mine car can be used. It is short and has a small wheel base, enabling it to go around sharp curves without excessive friction on the rail. As will be seen from the illustration, the height of the locomotive being only 32 in. the drivers can pass, without cramping, through places 42 in. high. This is one of the most important features, as in low seams a large amount of roof has to be taken down to admit mules for hauling, and where the roof is of sand rock this is very expensive; in fact, cases are known where a saving of $3 per yard has thus been made by using locomotives. It may be advanced that a rope system has just the same advantages; undoubtedly it has, but as against this equality with electric haulage, rope haulage has a great many disadvantages when compared with the electric system. The locomotive can pick up the trip from any part by simply throwing the switch leading to it and if necessary it can be used for switching and delivering any car irrespective of its place on the trip, to any branch. An extension of the haulage system can be made by simply carrying out the wire, without interfering with the rest of the system; there are no sheaves to take care of; no splicing of ropes; no constantly increasing dead load to carry.

The locomotive illustrated is rated at 3,000 lbs. draw bar pull at 8 miles per hour, but it has been tested on a dry rail and showed a draw bar pull of 5,000 lbs.; with sand, this can be raised to 6,500 lbs., giving a very powerful starting locomotive, enabling the operator to get his trip up to speed very quickly and without any jarring or throwing the coal off the cars, as is the case with steam or compressed air locomotives and more particularly with rope. On the level this locomotive has pulled, at a speed of 8 miles per hour, 65 cars, each car weighing 1,200 lbs. and containing 3,000 lbs. of coal, making in all a load of 136 tons. At this mine the coal is being hauled for 1¼ cents per ton per mile; before the haulage system was put in, counting in dead work necessary to admit mules, the cost was 7½ cents per ton per mile. This plant paid for itself the first 14 months.



MINE HAULAGE ELECTRIC LOCOMOTIVE.

An Interesting Mining Installation.

An interesting electric mining installation has been in operation for some time past near Croville, Butte County, California, at the Banner Mine of the Development Syndicate, of which Major Frank McLaughlin is general manager. The particular interest in this installation is due to the fact that all the power required for both the mining and the milling of the ore, is electric. The power station is about two miles distant from the mine and mill, and water is obtained from the Feather River, under 112 feet head, operating two Pelton water wheels, which, in turn, drive two 85-hp direct current, 500-volt General Electric generators.

The power supplied by the generators is utilized in driving motors operating separately a ten-stamp gold mill, a rock breaker, a 10″ by 20″ Rand air compressor, and two pumps on the 300 and 500 feet levels of the mine, of the Knowles vertical triplex, single-acting type, one with plungers of 6½″ diameter by 8″ stroke, and the other of the same type, with plunger of 5″ diameter by 6″ stroke. The hoisting works are also operated by an electric motor, and the mine and mill lighted from the power wires. Owing to lack of water for power the hoist has thus far only been operated intermittently; but a large bulkhead has been recently built, which will store sufficient water to allow of its operation at all times in connection with the other apparatus.

The following extract from a letter by Mr. Frank McLaughlin, general manager of Development Syndicate, indicates the success of the installation:

"I take great pleasure in stating that the electric power plant installed by your company at the Banner Mine, for operating the mill, rockbreaker, lighting system, air compressor, and the pumps on the 300 and 500 levels, works perfectly and to our entire satisfaction."

Financial Intelligence.

The Electrical Stock Market

New York, Dec. 8, 1894.

ELECTRIC STOCKS have made a very gratifying showing during the week ending to-day. The whole stock market has developed a gloomy tendency that ill accords with the bright prospects for rising quotations of a month or so ago, but electric stocks have evidenced a strength very pleasing to the holders thereof. That their quotations should hold is quite in keeping with the continued reports of increasing business that reach Wall street from the head offices of the various manufacturing and operating companies.

GENERAL ELECTRIC'S quotations have fluctuated very little, and that in a drooping stock market is more a sign of strength than it is significant of inactivity. The company's management insists that its operations are nowadays absolutely divorced from Wall street significance, and anything but a rise in General Electric's quotations fails to do it anything like justice. Business is as good as ever, if not even better than has been previously reported. The company is understood to be figuring on an especially important contract, namely, to equip the Manhattan Elevated Railroad of New York City with electric power. Mr. Russell Sage, an influential director of the Manhattan Company, admits that steam as a motive power is to be supplanted by electricity. Experts who have investigated the situation say that power can easily be applied to all the lines from one central station. Plans and specifications have already been drawn up and are in the hands of the General Electric people for an estimate. The contract calls for the equipment of some 257 motor cars, the erection of power plants, etc., and what with their experience in providing the equipment for the Metropolitan and West Side elevated railroad companies of Chicago, the General Electric people express themselves as fully satisfied with their ability to secure this important contract. The company just now, however, has plenty of work on hand to keep it busy. It is now working on the first lot of motors—500 of 25-horse power capacity—called for by the Yerkes Chicago Street Railway contract, secured several months ago. This valuable contract expressly stipulates that all the electrical apparatus used by the Yerkes system must be bought from the General Electric Company. With the big orders on hand the company is employing between 3,000 and 5,000 men, working full time at the Schenectady works, all the heavy machinery running day and night, while at the Lynn shops 2,000 men are at work, a good part of the plant being also operated at night. As to the financial side of the company's affairs, no action has as yet been taken regarding the correction of the impairment of capital, and, according to a statement in the Wall Street Journal, nothing will be done until after the annual meeting. Pending this matter, no dividend will be paid on the preferred stock, although it is being more than earned. But while there is a shadow of a doubt as to the legality of any such payment, the directors will be deterred from ordering it.

WESTINGHOUSE ELECTRIC preferred stock, as announced in these columns last week, is to receive a dividend of $1\frac{3}{4}$ per cent., the directors having ordered this week that preferred stockholders of record December 22, receive this quarterly payment on January 2 next. The payment is to be made in cash. Common stockholders are again left aside in the distribution of profits. The hopes of common stockholders receiving a share of the profits in the spring, are, however, understood to be well founded. Certainly the company is well in a position to make the payment, but it is deemed more advisable to lay aside a cash reserve. But the new Brinton works will prove a big source of profit to the company when one takes into account the improved methods of economical manufacturing introduced therein. The removal is being hastened as rapidly as possible and is expected to be completed by the first of the year. The week's quotations for Westinghouse Electric preferred and common stock issues show little change, nothing much baving been done in them on the exchanges.

AMERICAN BELL TELEPHONE stock quotations evidence few transactions if fluctuations are taken into account. The Governing Committee of the Boston Stock Exchange has refused to permit official dealings in rights of subscription at 190 to the 5,000 new shares of capital stock recently authorized, owing to the clause in the company's circular regarding terms of subscription to the effect that stockholders are made liable in case of a failure of an assignee to make full payment. Of a necessity this clause forbids promiscuous changing of ownership to the rights in question.

WESTERN UNION Telegraph also fails to show signs of weakness, there being no signs of investment liquidation and the floating supply of stock being so small as to discourage the bears to repeat their unsuccessful campaign of last summer.

ELECTRIC STORAGE BATTERY stock has been strong on the announcement that it has acquired the rights and patents of the Consolidated Electric Storage Company, the battery patents and rights of the Brush Electric Company of Cleveland, the battery patents and all interests in connection with batteries and the good will of that branch of the business of the General Electric Company, all the property rights and patents of the General Electric Launch Company and the Electric Launch and Navigation Company, and the rights, licenses and patents of the Accumulator Company. These purchasers would virtually place in control of the Electric Storage Company all of its former competitors in the business of supplying storage batteries and put an end to all litigation over patent rights. An official of the Consolidated Storage Company, the accumulator concern of the General Electric Launch Company, says of the Storage Battery deal: "Negotiations are pending towards a consolidation of all storage battery companies, though nothing has come to a head as yet. Accumulator concerns have used up all possible profits for the last ten years in patent litigation, and by combining we will stop fighting each other, as well as producing a storage battery which will have the best qualities of the accumulators now in the market." Since the announcement of a probable storage battery company consolidation, the Consolidated company's stock has gone up several points.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have purchased and cancelled 444 shares of preferred stock paying an average price of $105.72 per share, the highest yet paid. This makes 18,139 preferred shares cancelled to date.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	127	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	98½	100
" " " Brooklyn	100	109	112
" " " Boston	100	127	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	39	40
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	35½	36
General Electric, pref	100	70	72
Westinghouse Consolidated, com.	50	33	34
" " pref	50	50	51

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	107⅞	108
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	89½	90

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	198	200
American District Telegraph	100	35	40
American Telegraph & Cable	100	90	91
Central & South American Telegraph	100	102	105
Commercial Cables	100	130	145
Erie Telephone	100	52	53
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	88	88½

Ex-div.

THE ELECTRIC TRACTION STOCK market has failed to develop any particular feature during the past week, but quotations for out of town securities hold extremely well. Rumors come to hand of new consolidations, whose issues will be traded in here, the latest being a revival of the old story that all the New Haven, Conn., street railroads are to be consolidated, nearly all being now in one company. In Philadelphia, also, talk is still heard, despite contradictions, of coming unions of important electric railroad interests, while New York traders persist in telling the story that the Metropolitan Traction Company is to ally itself with the Manhattan Elevated Railroad, which is about to be equipped with electricity as a motive power.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	68	71
" " common	13½	15
Long Island Traction	13¾	14
Rochester St. Ry	40	41
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	56	58
North Shore Traction	22	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	106½	107
Philadelphia Traction	102	102½
People's Traction	55	55½

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. m. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	95	97

*With accrued interest.

Special Correspondence.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, December 8, 1894.

THE WEST END STREET RAILWAY COMPANY, Boston, has given an order for 110 motors, divided equally between the General Electric Company and the Westinghouse Electric & Mfg. Company.

THE PETTINGELL-ANDREWS COMPANY, Boston, is rearranging its display windows so as to neatly and tastefully exhibit its various electrical specialties. Its recently introduced "retail department" has already become quite a feature, and the trade is constantly manifesting its appreciation of it by liberal patronage.

THE NEW ENGLAND SCREW COMPANY, Boston, has every reason to congratulate itself upon its new and spacious quarters at 240 Dover street, that city. This company, by the way, enjoys with the electrical trade an excellent reputation and business recognition in its particular specialty, the manufacture of brass and iron machine screws, and Secretary and Treasurer T. P. Swift is just the man to hold trade and increase it.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY, Penacook, N. H., has appointed as its agent for the State of West Virginia and the western part of Pennsylvania, Mr. H. S. Sands, of Wheeling, W. Va., who will hereafter carry a line of its well known instruments sufficient to meet the wants of the trade in that territory. Mr. Sands has already made for himself quite a reputation as a contractor and engineer, and will undoubtedly make a success of this agency.

CHANDLER & FARQUHAR, Boston, dealers in machinists' supplies, etc., have removed to new and more commodious quarters at 36 Federal street, that city. The new quarters extend through from Federal to Congress street. This

firm needs no introduction to the electrical trade of New England, as it is favorably and generally known to everybody. Among its important agencies are the Garvin Machine Company, of New York, and the Lodge & Davis Machine Tool Company, of Cincinnati, Ohio.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
December 8, 1894.

MR. W. H. McKINLOCK has gone to New York for a short visit.

THE ELKHART TRANSFORMER continues to grow in favor, if orders are any indication. President Boss was a Chicago visitor during the week.

ROTH & ECK, of 32 Market street, are now making a specialty of dynamos of very small capacity, at remarkaby low figures. It will pay anyone to communicate with them.

MR. R. HUMFFREYS-ROBERTS, secretary and manager of the Fontaine Crossing and Electrical Company, of Detroit, Mich., was one of the most prominent of Chicago visitors during the week.

THE CHICAGO INSULATED WIRE COMPANY reports a very large order of wire sold to the North and West Side Street Railway Company amounting to 40,000. Business is very good with this company which has recently had to enlarge its factory at Sycamore to supply its enormous trade.

THE METROPOLITAN ELECTRIC COMPANY has nothing to complain of in the way of business. It is very busy in all departments, especially so with wires and cables. N. I. R. are three letters that seem destined to occupy the widest possble attention among the popular brands of wire in the west.

News of the Week.

NEW INCORPORATIONS.

THE UNIVERSAL ELECTRIC CONSTRUCTING COMPANY, Detroit, Mich., capital stock $5,500, has been incorporated by J. H. Talbot and others.

THE CITIZENS' MUTUAL TELEPHONE COMPANY, Lockport, N. Y., capital stock $15,000, has been incorporated by Jos. A. Ward, Wm. V. Trevor and others

THE WHITE HALL ELECTRIC COMPANY, White Hall, Ill., capital stock $10,000, has been incorporated by Gilbert S. Vasseller, Orlando F. Griswold and Henry W. Hand.

THE GLOUCESTER AND ROCKPORT STREET RAILWAY COMPANY, Gloucester, Mass., capital stock $40,000, has been formed to locate, operate, construct and maintain a street railway from Gloucester to Rockport.

THE RAVENNA ELECTRIC STREET RAILWAY & POWER COMPANY, Ravenna, O., capital stock $50,000, has been incorporated by Geo H. Worthington, Wm. J. Akers, Geo. W. Gardner, John H. Evans and R. B. Carnahan.

THE MADISON SQUARE LIGHT COMPANY, New York, N. Y., capital stock $1,000, has been formed to manufacture, use and sell electricity. The promoters are G. W. Moslin, A. J. Freeland, New York City, and R. D. Lankford, Brooklyn, N. Y.

THE WINAMAC ELECTRIC LIGHT & POWER COMPANY, Winamac, Ind., capital stock $10,000, has been formed to manufacture and supply electric light and power. John H. Weaver, Moses A. Dilts and Isaac V. Smith are the organizers.

THE HOME TELEPHONE COMPANY, Plain City, O., has been incorporated by W. C. Bollinger, W. H. Schierer, Charles Dun, J. C. Thompson, J. A. Kile, A. Lee Seeley, G. W. Gardner, Albert Hauer and F. N. Mattoon. The capital stock is $5,000.

THE UPPER CICERO WATER & LIGHT COMPANY, Austin, Ill., capital stock $50,000, has been formed to furnish electric light, heat and power, to lay water and gas pipes, etc. Lawrence Crook, Joseph Foschinbaur, Revere Lincoln and Daniel Schustick are the incorporators.

THE GREENSBURG, JEANNETTE & PITTSBURG STREET RAILWAY COMPANY, Carlisle, Pa., capital stock $150,000, has been formed to construct, maintain and operate an electric street railway. W. F. Sadler, A. A. Thomson and W. F. Sadler, Jr., of Carlisle, Pa., are the promoters.

THE CHATHAM ELECTRIC LIGHT & POWER COMPANY, Savannah, Ga. capital stock $25,000, has been incorporated to operate electric light and power plants. The promoters are George Parsons, James H. Johnston, John N. Harriman, Ed. J. Thompson and others, to operate electric light and power plants.

THE CORNING & PAINTED POST STREET RAILWAY, Corning, N. Y., capital stock $100,000, has been formed to build and operate an electric street railway five miles long between the towns of Corning and Painted Post. The interested parties are E. W. Sheed, W. H. Tylee, Worcester, Mass., and H. A. Clark, Corning N. Y.

THE ROGERS PARK LIGHTING COMPANY, Chicago, Ill., capital stock $30,000, has been formed to generate, buy and sell electricity, and to manufacture gas; also to construct and lay all necessary wires, pipes, poles, conduits and appliances for the distribution thereof. Henry Heistand, Geo. N. Stone and Lloyd G. Kirkland are the promoters.

THE DELAND ELECTRIC RAILROAD & POWER COMPANY, De Land, Fla., capital stock $300,000, has been formed to construct, maintain and operate a railway with electricity as a motive power, and also to supply electric current for lighting, etc. John B. Stetson, Theodore Search, Philadelphia, Pa., and John F. Forbes, DeLand, Fla., are the promoters.

THE MAHONING VALLEY ELECTRIC RAILWAY COMPANY, Niles, Ohio, capital stock $150,000, has been formed to construct and operate street railways by electric or other motive power, excepting horse or steam power, in Niles, Girard and Youngstown, and between these towns. C. F. Clamp, R. G. Sykes, Arthur A. Anderson, G. E. Herrick, Andrew Squire and John E. McVey are interested.

THE RAVENNA ELECTRIC STREET RAILWAY & POWER COMPANY, Ravenna, O., capital stock $50,000, has been formed to build, operate and maintain electric railways within the limits of Portage County, Ohio, and elsewhere; also to furnish electric power, light and heat, etc. George H. Worthington, Wm. J. Akers, George W. Gardner, J. H. Evans and R. B. Carnahan are the promoters.

THE AMERICAN GAS ENGINE ELECTRIC COMPANY, Chicago, Ill., capital stock $250,000, has been formed for operating patents for producing power by gas engines, electric motors, etc.; generating electricity for light, heat and power, and to manufacture electric cooking, heating and refrigerating apparatus. Erik Akerberg, J. Ensign Fuller and Albert P. Dexter are the interested parties.

THE MERCED RIVER POWER AND WATER COMPANY, San Francisco Cal., capital stock $1,000,000, has been formed to build and operate railways, bridges, telegraph and telephone lines, water-works, flumes, dams, and to distribute water, electricity, etc. G. A. Wulkop, Merced; Sumner W. Bugbee, Oakland; H. L. Norton, F. C. Roberts, and W. S. Morgan, San Francisco, Cal., are the interested parties.

ELECTRIC LIGHT AND POWER.

MORRIS, N. Y., is in need of an electric railway and electric lights.

SCHENEVUS, N. Y.—The question of electric lighting is being agitated.

HARTFORD, CONN.—The matter of placing electric wires underground is being agitated here.

WENONA, ILL.—A special election will be held to vote on the question o lighting the city by electricity.

GADSDEN, ALA.—The capacity of the Queen City Electric Light Company's plant will be largely increased.

RUSHVILLE, ILL.—Rushville wants more electric lights. An 85-hp engine will be added to the present plant.

KIRKLAND, ILL.—The citizens are talking of establishing an electric lighting plant. Address H. B. Rowen.

PANAMA, N. Y.—The village trustees have voted to procure street arcs for the borough. About 36 lamps will be required.

ERIE, PA.—The city clerk was instructed to advertise for bids for street lighting for the year commencing in April next.

ONTONAGON, MICH.—An electric plant to be run by water power at the falls of the Ontonagon river, is among the probabilities.

BERWYN, PA.—Citizens are talking about having the streets lighted by electricity, the current to be brought from the plant at Wayne.

DANSVILLE, N. Y.—The committee on county buildings have been directed to ascertain the expense of fitting up the county buildings for electric lighting.

SHAWANO, WIS.—The council has rejected both bids submitted for the purpose of furnishing the city with electric light, for the reason that they were considered too high.

LANCASTER, PA.—The Lancaster Gas Light and Fuel Company has applied for an alteration of its charter and the change of name to the Consolidated Gas & Electric Company. H. B. Baumgardner is president.

CARTHAGE, MO.—Press states that Mr. A. O. Ihlseng is preparing to operate continuously his mines in the southwestern suburbs, and also to construct an electrical light plant for lighting the works above ground.

WHEELING, W. VA.—A charter has been granted the Suburban Light & Water Company, of Wheeling, with a capital of $500,000, to build an electric light and power plant and water works to supply half a dozen suburban villages.

PHILADELPHIA, PA.—At a convention of delegates of the Peoples' Party it was resolved that the city build and operate an electric light plant, sufficiently large to adequately supply, at cost, the public and private needs of the city.

MILWAUKEE, WIS.—At the meeting of the Council resolutions providing for the operation of the Broadway and the Oneida street bridge by electricity, at a cost of $875 for the Broadway bridge and $600 for the Oneida bridge, were reported.

RALEIGH, N. C.—The stockholders of the Raleigh Electric Company have decided to authorize an issue of $25,000 of first mortgage bonds for the purchase and installation of its electric light plant, and to improve and enlarge its railway equipment.

PLAINVILLE, CONN.—The Plainville Electric Light & Power Company has been organized. The stockholders are C. S. Landers, trustee for Central Railway & Electric Company; W. H. Brayton, M. B. Hitchcock, E. F. Tomlinson and others. The capital is $10,000.

PHILADELPHIA, PA.—The Common Council has granted the Edison Electric Light Company the privilege of laying its conduits throughout the business section of the city between South and Callowhill streets, and the Delaware and Schuylkill Rivers without compensation.

WINNIPEG, MAN.—The Council of the city of Winnipeg, Manitoba, is prepared to receive proposals for the establishment and operation of works for the supply of gas or gas and electric light for the lighting of buildings. Proposals will be received until January 22, 1895.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Manufacturing Company submitted to the Common Council its plan for constructing one of its lines for transmitting electricity for power, heating and lighting purposes. The matter was referred to the Street Committee.

BLOOMFIELD, N. J.—The Bloomfield Township Committee on Public Lighting has been authorized to advertise for bids for supplying the town with 100 2000-cp electric lights. A local electric light and power company is being organized in the town for the purpose of bidding for the contract.

BESSEMER, ALA.—The Howard Harrison Iron Company has closed a contract for the electrical equipment of its revolving cranes in their foundry. Each of five cranes is to be equipped with two 10-hp and one 30-hp motor. Power is to be furnished from a 150-kw 500-volt generator.

THE ELECTRIC RAILWAY.

NEW BRITAIN, CONN.—The Central Railway & Electric Company has asked permission to extend its lines.

SOMERSET, MASS.—There is much probability of a spirited contest for an electric railroad franchise in this town.

WORCESTER, MASS.—The Natick Electric Street Railway Company has about completed its line to South Framingham.

NORTHAMPTON, MASS.—The Northampton Electric Railway Company is to be extended to East Hampton at a cost of $100,000.

SAVANNA, ILL.—J. B. Canterbury, of La Crosse, Wis., is interested in organizing a stock com pany to construct a street car line in Savanna.

DETROIT, MICH.—The City Council has granted a franchise to representatives of the Park-Everett syndicate for another electric street railway line.

JAMAICA, L. I.—After innumerable delays and postponements the contract giving a franchise to the Long Island Electric Company was executed December 3.

PEEKSKILL, N. Y.—The Peekskill, State Camp and Mohegan Railway Company has received a franchise to build an electric street railway in Peekskill.

WELLSTON, O.—The Wellston Belt and Street Railway Company has filed an amendment changing its name to the Wellston & Jackson Belt Railroad Company.

HOBOKEN, N. J.—The stockholders of the Bergen Turnpike Company have given the directors power to issue bonds to build a trolley road from Hackensack to Hoboken.

CRAWFORDSVILLE, IND.—C. E. Loss & Company have been awarded the contract to construct the Anderson and Muncie Electric Railway. The price to be paid, it is stated, is $525,000.

ORANGE, N. J.—The Suburban Traction Company has passed into the hands of a receiver. The company's resources are stated to be $500,000 and its liabilities $1,500,000 in bonds, and $141,000 in debts.

GRAND RAPIDS, MICH.—J. H. Roberts, it is reported, will put an electric railway around Mackinac Island at a cost of $100,000, and will also establish an electric light plant which will cost $50,000.

HARRISBURG, PA.—The Cumberland Valley Railroad will extend its lines to Carlisle. The company proposes putting in an electric trolley system on its own line between Harrisburg and Dillsburg in the spring.

DOYLESTOWN, PA.—The first work on the Doylestown trolley line has been commenced under supervision of ex-Register Frank N. Booz. A force of workmen began the erection of poles along Maple avenue.

GREENVILLE, N. J.—The Common Council will consider the petition for a franchise presented by the Jersey City, Hoboken & Rutherford Electric Railway Company to operate a trolley system along the Paterson plank road.

VANCOUVER, B. C.—The Street Railway and Electric Light Company has been sold to an English syndicate. Notice of dismissal has been given all employees and the new company intends to completely reorganize the staff.

SOUTHBORO, MASS.—The new company known as the Marlboro and Westboro Street Railway Company has petitioned the Board of Aldermen of Marlboro for a right to lay a track to Northboro, going over the westerly part of Southboro.

BATAVIA, N. Y.—A franchise for an electric street railway in Batavia and to Horse Shoe Lake has been granted to the Batavia Street Railway Company. The New York Standard Construction Company, 97 Nassau street, has the contract for construction.

ALBANY, N. Y.—It is rumored that should the proposed new bridges across the Hudson at Bath and between Green Island and Troy be erected, an electric railroad belt line will be constructed between Troy and Albany. When the new bridge from Troy to Green Island is built the tracks of the Troy City road will be laid across it.

KINGSTON, N. Y.—The Colonial City Electric Railway Company has asked for consent of the Common Council of the city of Kingston to build, maintain and operate a trolley system on its railway in certain streets of the town. David Kennedy is Mayor.

DUBOIS, PA.—Adjutant General W. W. Greenland is interested in having the Beach Creek road extended from Dubois to Franklin, where it would connect with the Lake Shore and form a trunk line to include Clarion. The General says the extension will undoubtedly be made.

SOUTH WILLIAMSPORT, PA.—The South Williamsport Railway Company has secured a charter permitting it to extend its line from the present western terminus at Maynard street on through to DuBois town. The company have decided to begin the work of construction next spring.

NEWARK, N. J.—The Consolidated Traction Company is building a large power house to take the place of its old 3,000-hp Boyd street plant. The electrical equipment of the old plant consists of 14 units, Edison, Westinghouse and T.-H. generators. The new station will have only large units 500 to 1,000-hp each.

BRIDGEPORT, CONN.—The Bridgeport Traction Company is installing an additional 500-kw direct coupled generator in its power station. It was necessary to secure a truck from New York to haul the armature from the freight yard to the power house, as no local truck was strong enough to support the twenty-ton weight.

TRAVERSE CITY, MICH.—Articles of association were filed for a standard gauge electric railway from Traverse City to Old Mission, 20 miles, with a capital stock of $160,000. It is intended to be a freight and passenger line. The incorporators are ex-Judge Jonathan G. Ramsdell, L. K. Gibbs, Harry L. Gibbs and others.

ALBION, N. Y.—The International & Oak Harbor Railway Company has applied for a charter to construct a railway to be operated by steam, electricity or other power from Albion, Orleans County, to Lake Ontario, a distance of ten miles. The capital is $175,000, and the directors are George A. Wingate, Jacob Cole, of Albion, and others.

DEPERE, WIS.—James H. Elmore and Frank Van Derzee have been granted a franchise by the City Council for an electric street railway connecting with the Green Bay system, upon the condition that the railroad shall cross the river on a bridge of the railway company's own construction and run to the Chicago & Northwestern depot.

PHILADELPHIA, PA.—At a special meeting of the stockholders of the 22nd street and Allegheny Avenue Passenger Railway Company a resolution recommending several extensions, submitted by the Board of Directors, was approved, and the officers authorized to take steps to obtain authority for the construction of the proposed extension and to proceed with their construction.

SWEDESBORO, PA.—What was thought to be a scheme to be force the Camden, Gloucester & Woodbury Company to build a road from Woodbury to this place has developed into the formation of a permanent company which will operate a road between these two points. The right of way has been secured over the Salem and Woodbury turnpike from this place to the terminus of the road in Woodbury.

SOUTH FRAMINGHAM, MASS.—The South Middlesex Electric Street Railway Company will extend its line to Ashland and Hopkinton. The directors for the ensuing year are W. B. Ferguson, of Malden; Thomas T. Robinson, of Dedham, and others. The president is W. R. Ferguson; clerk and treasurer, Joseph J. Valentine. The treasurer's office and headquarters will be at South Framingham.

WOODBURY, N. J.—It is now proposed to run an electric road by the underground conduit system between this city and Swedesboro. The company claim to have secured an option on the stock of the latter company and the road will be completed by summer. The route embraces Delaware street to Jackson, to High, to Glower, to Penn, to Morris, to Salem avenue, then over the turnpike to Clarksboro and Swedesboro. Reported at Swedesboro, Pa., Dec. 3rd.

PITTSBURG, PA.—Charters have been issued for three new street railways in Pittsburg, two being controlled by the same parties, the Baum Street and Highland Park Street Railway Companies. The other is the Liberty Traction Street Railway Company. The Baum Street Railway Company is capitalized at $10,000, and will build a line about a mile long; and the Highland Park Street Railway is capitalized at $25,000 and will build a line three miles long; Senator William Flinn, of Pittsburg, is president of these two companies, and Joshua Rhoades, William C. Lynne, James A. Fortune, Wm. McAdams, Pittsburg, are directors. The Liberty Traction Company is capitalized at $70,000. The company will build a line of ten miles from the intersection of Eleventh street and Spring alley. The president is John F. Scott, Pittsburg, and the directors are Geo. S. Davison, P. Rhoades Baker, W. F. Bickell, of Pittsburg, and others.

Trade and Industrial Notes.

MESSRS. H. B. COHO & CO., 203 Broadway, New York, have received the order for electrical machinery for the new Coffee Exchange, New York City, through the Metropolitan Electric Equipment Company.

LINTON & SOUTHWICK, Worcester, Mass., in a recent catalogue illustrate and describe a number of their electric light, power and switchboard fittings.

THE PHILADELPHIA ELECTRICAL & MANUFACTURING COMPANY has moved its works from 1710 Barker street to Twentieth and Jones streets, Philadelphia.

QUEEN & COMPANY, Philadelphia, Pa., we learn, consider the prospects excellent for a speedy adjustment of their affairs. Meanwhie their large stock has suffered little diminution and is being kept up in all departments, orders being filled as usual.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, 1108 Charles street, St. Louis, Mo., has issued a new discount sheet applying to its new 15-ampere 500-volt switch. This switch has been designed to meet underwriters' requirements and has met with much success.

THE INTERIOR CONDUIT & INSULATION COMPANY, 44 Broad street, New York, has received notice from the New York Board of Fire Underwriters that it has amended Rule 22 so as to prevent twin conductors to be used in a complete, fully-insulated, continuous iron conduit.

MARK A. REPLOGLE, Cedar Falls, Iowa, is applying his turbine regulator to a pair of Leffel's horizontal Samson wheels at Burlington, Vt., used to furnish power to street railway generators. Mr. Replogle has met with much success with his system for controlling the speed of turbines under variable load.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, in a handsome 8-page pamphlet describe and illustrate a number of its incandescent arc and series arc lamps. The principle of the incandescent arc is clearly shown in two cuts and there are several cuts showing the handsome manner in which the lamps are finished.

CHICAGO INSULATED WIRE COMPANY, Northern Office Building, Chicago, requests us to give publicity to the fact that the present Chicago Insulated Wire Company is a separate and distinct corporation and has no connection whatever with the Great Western Manufacturing Company, as reported in a dispatch in the daily press, the old charter having been surrendered and a new company formed.

J. E. DUVAL, contractor and construction engineer, having headquarters at Charlotte, N. C., has been unusually successful in this fall's business. During the last sixty days he has installed three new Loomis slow speed generators, two 250-light and one 350-light, besides three of a smaller size. Trade is booming among the cotton mills in the South, and Mr. Duval seems to be getting his share of the lighting business.

J. GRANT HIGH & COMPANY, 123 N. Third street, Philadelphia, and 807 Medina Temple, Chicago, have met with much success with their new high tension switch. This style of switch is at the present time in use on the Roxborough and Inclined Plain Railway and the Pottston and Ringing Rocks road, and they are fitting out with these switches several large railway boards under construction in their shop at the present time.

M. T. DAVIDSON, Brooklyn, N. Y., with New York headquarters at 77 Liberty street, has recently filled some big orders for Davidson pumping engines. One for the water-works of the city of Chelsea, Mass., is a splendid piece of work, as is also a pumping engine of similar magnitude and design for the water-works at Fall River, same State. A large order from a prominent phosphate company in Florida consisted of the entire equipment of its steam plant, including boilers, pumps, etc.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has orders for a number of its new type of electric locomotives, both for the anthracite coal district as well as the bituminous district. As this company is specially fitted up in its machine shops for designing and manufacturing this class of machinery, it claims that it can both build and sell a cheaper and better locomotive than companies devoted to the manufacture of this apparatus only as a small side line.

THE EUREKA TEMPERED COPPER COMPANY, North East, Pa., has issued a neat 40-page catalogue of its manufactures of tempered copper for electrical and mechanical purposes. Numerous lists are given of the various types and sizes of commutators for which this company supplies the segments, or the commutator complete if desired. Other articles mentioned are brushes of all the types used on the different commercial machines, woven wire brushes, street car bearings and gears, trolley wheels, brush holders, soldering coppers, Eureka wire, etc.

THE STANDARD PAINT COMPANY, 2 Liberty street, New York, reports that the Metropolitan Electric Company, 186 Fifth avenue, Chicago, has of late sent them some very large orders for P. & B. compound motor cloth and tape, especially the last named article, it having within the last month alone ordered several thousand pounds of P. & B. insulating tape. Although the Metropolitan Electric Company took up the sale of these goods during the recent hard times, and has been handling them but little over a year, it in that time has doubled the P. & B. electrical business in the West.

THE HAWLEY DOWN DRAFT FURNACE COMPANY, 805 Security Building, Chicago, has issued a large, handsomely printed and illustrated catalogue devoted to the Hawley down draft smoke-consuming furnace. In a recent proposition made by the Hawley Company to the Chicago School Board, the following guarantees were offered as to the efficiency of the Hawley furnace: First—To consume 95 per cent. of the smoke, burning any grade of bituminous coal; second—To make steam for one-half the cost of doing it with hard coal; third—To make steam at 15 per cent. less than present cost with soft coal; fourth—To develop sufficient steam power to furnish all heating and power needed.

S. MORGAN SMITH, of York, Pa., manufacturer of "Success" and "McCormick" turbines, reports the following sales. Ten horizontal iron cased wheels rated at 6,000-hp for the Sacramento Power & Light Company, of San Francisco, Cal., for its plant at Folsom. This is one of the largest power plants in the country; the power will be transmitted 21 miles to Sacramento. The plant will probably be in operation early in the spring. Also horizontal wheels aggregating about 2,000-hp for the Minneapolis General Electric Company, of Minneapolis, Minn. Six wheels aggregating about 900-hp were recently furnished the Home Electric Light & Power Company of Elkhart, Ind.; three wheels and power connections for the electrical plant of the International Pulp Company, Gouverneur, N. Y.; three horizontal wheels of 600-hp and power connections for the new plant of the Mauch Chunk, Heat, Light & Power Company, Mauch Chunk, Pa.; one wheel of 100-hp for an electrical plant at Juneau, Alaska, and one of 275-hp to Salvador, San Salvador.

THE J. H. McEWEN MANUFACTURING COMPANY, Ridgway, Pa., reports the following as among its recent engine sales: Two 150-hp simple, direct connected to General Electric generators, Continental Hotel, Philadelphia; one 350-hp simple direct-connected to Walker generator, to Akron Street Railway Company Akron, Ohio; two 60-hp tandem compounds, direct-connected to C & C generators, to Dundee Rapid Transit Company, Elgin, Ill.; one 50-hp simple, to Parmele-Eccleston Lumber Company, Jacksonville, N. C.; two 130-hp tandem compounds to R. Dunsmir & Company, San Francisco, Cal.; two 300 hp to Granite Steel Company, East St Louis, Mo.; one 150-hp simple engine to Huntingdon Electric Light Company, Huntingdon, Pa.; one 175-hp to J. H. Somers Fuel Company, Belle Vernon, Pa.; one 280-hp tandem compound to Scranton Electric Construction Company, Scranton, Pa.; one 125-hp simple to New York & Pennsylavinia Company, Johnsonburg, Pa.; one 85-hp simple to Independent Electric Company, Atchison, Kansas; one 100-hp to New York & Scranton Coal Company, Shippler, Pa.; one 175-hp simple to Walter & Ferris Coal Company, Salem, Ohio, and one 125-hp simple to Scranton Electric Construction Company, Scranton, Pa.

Business Notices

A RAILROAD DOCTOR'S PRESCRIPTION.—General Western Agent C. K. Wilber, of the Lake Shore & Michigan Southern Railroad, with headquarters at Chicago, is, without trying, one of the really funny men of the railroad world. The other day, for example, he accomplished this advertisement, which old hands at the business truly say is one of the brightest little things ever put on paper:

R

The Lake Shoe Limited taken regularly on your Eastern trips will prevent that tired feeling so often experienced by travelers.
Leaves Chicago, V.XXX P. M.
Arrives New York, VI.XXX P. M.

C. K. WILBER,
W. P. A.

Can be taken without shaking.

General Passenger Agent Daniels says that Dr. Wilber's prescription is equally efficacious on trains of the New York Central, he having this assurance from Drs. Cosby and Dumond, who have tried it with perfect success. General Passenger Agent Fee, of the Northern Pacific, has offered to all his local agents and subordinates a handsome prize in money for the best advertisement of the line, and it is obviously well for them that Mr. Wilber "isn't in it."—*Brooklyn Standard-Union.*

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 5, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

530,082. TELEGRAPH KEY; Louis D. Bliss, Washington, D. C., assignor to Charles W. Needham, of same place. Application filed March 7, 1894. A noiseless transmitting key, comprising a non-resonant support, and a contact mounted on the support.

530,088. BRUSH FOR DYNAMO-ELECTRIC MACHINES; Pierre Joseph Charles Carron, Pont-de-Claix-Isere, France. Application filed February 10, 1894. A brush for an electrical machine comprising a sheet of wire gauze, coated and impregnated with a paint composed of plumbago and an adhesive substance, the said coated sheet having its main portion arranged in zig-zig folds and its outer portion wrapped about the folded portion and its free end secured.

530,093. ELECTRIC RAILWAY SIGNALING; W. Daves, Jersey City, N. J. Application filed May 24, 1894. The combination of a signal circuit, a normally de-energized track circuit controlling the signal circuit and including the rails of a section of the track, a second normally close track circuit controlling the first mentioned track circuit and including the rails of a separate section of the track.

530,114. METHOD AND MEANS FOR OPERATING AND CONTROLLING ELECTROMOTORS; Carl Moderegger, Vienna, Austria-Hungary, assignor to Siemens & Halske, Berlin, Germany. Application filed December 16, 1893. The method of operating and controlling an electromotor which consists in passing a current through the motor in either direction; and automatically reversing the current and varying the resistance of the circuit simultaneously after a determined period of operation.

530,115. TELEPHONE TRANSMITTER; Miles A. Morehouse, Watertown, N. Y. Application filed March 28, 1894. In a telephone transmitter, the combination with the transmitter box and the vibrating diaphragm, of an electrode bar rigidly connected with one side of the diaphragm, paralleled supporting wires arranged horizontally within the top of the transmitter box, and pendant electrodes adjustably connected at their upper ends to said wires and arranged to rest on said electrode bar at an angle.

530,122. SIGNAL APPARATUS; Charles E. Ongley, New York, N. Y., assignor to George J. Schoeffel, of same place. Application filed February 17, 1894. The combination of a signal device, a compass, a switch operated thereby, and means thrown into operation by said switch for operating said signal devices to indicate the points of the compass.

530,141. SERVICE END, CUT-OUT, AND SWITCH-BOX FOR ELECTRIC-LIGHTING CIRCUITS; John VanVleck, New York, N. Y. Application filed May 28, 1894. The combination of house mains and service cable having conductors, provided with flexible end portions at their extremities, threaded bolts, enclosing said end portions and bolts, and a switch mechanism secured to said box and connected with said house mains and said bolts.

530,145. ELECTROMETER; Edward Weston, Newark, N. J.—Application filed April 26, 1893. In an electrometer containing two fixed electrodes and a movable body susceptible of electrification and disposed in inductive proximity to said electrodes, an index for showing the extent of movement of said movable body supported by said body and insulated therefrom.

530,176. ALTERNATING CURRENT MOTOR AND METHOD OF OPERATING SAME; L. Gutmann, Pittsburg, Pa. Application filed October 30, 1889. This consists of establishing a field of rapidly varying intensity by a single-phase alternating or pulsating current, and producing in a motor element whose winding is exposed to the field of force polyphase currents in successive closed circuits of the winding.

530,177. ALTERNATING ELECTRIC MOTOR; Ludwig Gutman, Pittsburg, Pa. Application filed December 23, 1891. The method of transforming electrical into mechanical energy, which consists in subjecting the stationary and rotary elements of a motor to the influence of a uniphase alternating current, establishing in a supplemental winding bi-phase or polyphase currents, and subjecting said supplemental winding to the influence of a magnetic field.

530,178. ELECTRIC CONVERSION SYSTEM; Ludwig Gutman, Pittsburg, Pa. Application filed December 23, 1891. The combination with a single phase alternating current generator of a self-starting synchronous motor-generator in circuit therewith, a commutator for commutating the currents from said motor-generator and translating devices in local consumption circuits fed by said commutated current.

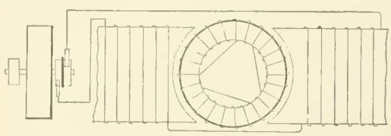
530,184. CIRCUIT-CLOSER; Herbert Vivian Keeson, London, England. Application filed September 17, 1894. The combination of a block or body, an electric circuit through conductors in it, a break in the circuit and two pushes carried by the block or body and acting at right angles or approximately at right angles to each other and closing the said circuit when both are operated simultaneously.

530,191. APPARATUS FOR EXTINGUISHING FIRES; Charles E. Manning, New York, N. Y., assignor to Addison Allen, of same place. Application filed September 9, 1893. An apparatus for extinguishing fires in buildings, comprising a source of water supply, and a source of electricity, an electric motor, a pump driven thereby, electric wires connected to said source of electricity and to said motor, electric switches adapted to close the circuit through said wires and operate said motor, water pipes leading from said water supply to said pump, and from said pump through the building a plurality of branch pipes, and independent valves for each leading from said water pipes, and a hose connected to each of said branch pipes.

530,192. ELECTRIC RAILWAY SYSTEM; David Mason, New York, N. Y. Application filed February 16, 1894. The combination, with a working conductor, and a main conductor or lead, of means whereby the working conductor may be heated, and electrical connections between the main and working conductors.

530,208. TELEPHONE SWITCH; Alfred Stromberg and Androv Carlson, of Chicago, Ill. Application filed October 9, 1894. In a telephone switch, the combination with the support comprising a hook provided with two limbs between and from which the telephone is adapted to be suspended, of a pivoted lever, the end thereof occupying a position between said limbs, whereby said lever will be rotated when the telephone is hung up, and contact terminals controlled by the rotation of said lever for opening and closing the circuits through the telephone apparatus.

530,235. MAGNETO-ELECTRIC MACHINE; Joseph N. McLeod, Brooklyn, N. Y. Application filed April 2, 1894. In a magneto-electric machine, the combination with the rotary armature, and the toothed rack bar and ratchet wheel for operating said armature, of a circuit breaker consisting of the



No. 530,176.—Alternating Current Motor.

stationary and movable parts normally in contact and connected in the local circuit and respectively connected with the line wires, the lever connected with the movable part of said circuit breaker, the collar connected with the lever and the tappet arm of the ratchet wheel adapted to have contact with the collar to break the circuit when the rack bar nearly reaches the end of its movement for operating the armature.

530,236. SIGNALING APPARATUS; Bernice J. Noyes, Boston, Mass., assignor to George W. Gregory, of same place. Application filed February 18, 1890. In a signaling apparatus, a main signaling circuit connecting street boxes, a central station, and a wagon house, a receiving instrument at the receiving staton for receiving all signals, combined with a receiving relay at the wagon house, a retarded armature therefor, a local circuit controlled by the said retarded armature, and two receiving instruments in said local circuit, one at the wagon house and the other at the central station.

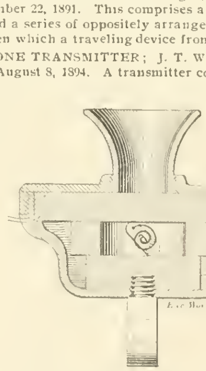
530,253. ELECTRIC BELL; Edward G. Worley, New York, N. Y. Application filed June 13, 1894. In an electric signalling device, the combination on a casing, magnet, an armature and hammer, a back contact spring supported on said casing but insulated therefrom and connected with the coils of the magnet, an insulated stop supported on the casing in front of said spring, and adjusting screw mounted in the casing and having an insulated point to bear on the spring, and connections for the conductors.

530,260. PRIMARY BATTERY; Charles W. De Mott, New York, N. Y. Application filed December 7, 1893. The combination in a primary battery of the jar, the porous cup, the zinc electrode and a copper electrode having the parallel slits and the strips between the slits bent out of the place of the rest of the tube whereby ci culating passages are provided for the solution without lessening the surface area of the copper electrode.

530,276. TROLLEY-CATCHER; William F. Kendt, Buffalo, N. Y., assignor of two-thirds to George M. Mitchell and Rod McLeod, of same place. Application filed May 26, 1894. In a trolley-catcher the combination with a stationary frame or casing having a stop or shoulder and a rotary spring-drum journaled therein, of a detent pawl carried by said drum and engaging with a stop or shoulder of the casing, and a link pivoted to said pawl and adapted to be connected with the trolley rope.

530,286. ELECTRIC TRAMWAY; H. Schwieger, Berlin, Germany. Application filed December 22, 1891. This comprises a conduit, contacts arranged in the conduit, and a series of oppositely arranged yielding guards within the conduit, between which a traveling device from the car is arranged to pass.

530,315. TELEPHONE TRANSMITTER; J. T. Williams, Brooklyn, N. Y. Application filed August 8, 1894. A transmitter consisting of two circuit termi-



No. 530 315, Telephone Transmitter.

nals, in combination with a conducting body forming an electrical bridge between them and mounted upon a movable axis whereby it may automatically adjust its position with relation to the terminals.

530,324. TELEPHONE EXCHANGE SYSTEM; R. Callender, Brantford, Canada. Application filed August 13, 1892. Means for automatically connecting any two of a series of independent outlying telephone lines, a time mechanism for automatically disconnecting at the central office the subscribers after a predetermined time, which time mechanism is in no way under the control of the subscriber after the expiration of the predetermined time.

530,325. TELEPHONE SWITCH; R. Callender, Brantford, Canada. Application filed September 15, 1894. A sustaining device which fails to hold the receiver when the receiver is being used in combination with a switch and circuit connections to the call bell and receiver, the switch being provided with means acting conjointly with the support to hold the receiver only when the circuit is closed through the bell.

530,343. ELECTRIC LIGHT FIXTURE; H. Horn, Philadelphia Pa. Application filed May 24, 1894. This comprises an immovable portion adapted to support a shade, another portion removably connected with the former, the removable part being provided with an open top reflector, the latter being adapted to support and conceal lamp sockets.

530,344. ELECTRIC DENTAL ENGINE; J. A. and B. A. Jeffery, San Francisco, Cal. Application filed April 5, 1894. This comprises a case swiveled upon a bracket, a two part shaft, upon one part of which the motor armature rotates within the case, while the other is journaled in a sleeve extending outwardly in a line with the axis of the motor armature, and a clutch connection between the two parts of the shaft whereby they may be separated when the end of the case is removed.

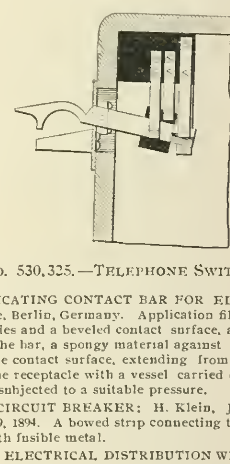
530,351. ELECTRIC METER; G. A. Scheefer, Peoria, Ill. Application filed July 17, 1894. This comprises a rotatable element moved by the current to be measured, a coil connected in parallel with the working circuit, a second coil in inductive relation thereto, the coils being adapted to coact to neutralize the effects of friction.

530,368. BILGE WATER ALARM; C. Upton, Salem, Mass. Application filed February 1, 1894. This comprises a case with terminals, a vertical guide rod within the case, a float guided on the rod, a spiral spring seated on the float and ranging vertically on the case, and a contact plate yieldingly supported on the spring.

530,399. INSULATOR FOR ELECTRIC CONDUCTORS; J. H. Croskey and J. Locke, Pittsburg, Pa. Application filed September 28, 1894. This consists of a metallic conductor covered with a non-metallic mineral and embedded in glass.

530,401. BATTERY CONNECTION; W. S. Doe, Brooklyn, N. Y. Application filed August 27, 1894. This comprises a contact disk surrounded by an elastic ring, and a binding post in electrical connection with the disk.

530,411. BURGLAR ALARM FOR SAFES; J. W. and W. D. Gilstrap, Rolla and Racine, Wisconsin. Application filed April 24, 1894. This comprises a safe, an inner envelope, insulated springs supporting the envelope on the safe, contacts carried by the envelope to touch the safe, an alarm, and a circuit including the safe, the envelope and the alarm.



No. 530,325.—Telephone Switch.

530,416. SELF-LUBRICATING CONTACT BAR FOR ELECTRIC RAILWAYS; F. W. N. E. Hayne, Berlin, Germany. Application filed May 12, 1894. A bar having vertical sides and a beveled contact surface, a receptacle for a lubricant adjacent to the bar, a spongy material against the sides for conveying the lubricant to the contact surface, extending from the receptacle, and a tube connecting the receptacle with a vessel carried on the car and containing the lubricant subjected to a suitable pressure.

530,430. THERMAL CIRCUIT BREAKER; H. Klein, Janesville, Wis. Application filed May 19, 1894. A bowed strip connecting two terminals, the strip being fastened with fusible metal.

530,432. SYSTEM OF ELECTRICAL DISTRIBUTION WITH STORAGE BATTERIES; E. Kuchenmeister, Berlin, Germany. Application filed November 25, 1892. This comprises a generator, circuit and translating devices, a storage battery divided into uniform sections and having one section connected permanently across the circuit and means for connecting the remaining sections in series with the first section, or in parallel with it across the circuit when desired.

530,434. BURGLAR ALARM; J. H. Lowe, Neosho, Mo. Application filed July 20, 1894. This comprises a cage, a case containing noxious fluids under pressure, a valve for same, an atomizing device in the case, circuit closing mechanism in the cage, and means for opening the case valve by the closing of the circuit.

530,465. DYNAMO REGULATOR; J. Van Vleck, New York, N. Y. Application filed October 8, 1894. This comprises two parallel series of contact plates, the plates of one series being opposite the intervals of the other, resistances being interposed between successive plates of each series and a contact piece equal in width to one of the plates and movable over both of the series.

530,472. ELECTRIC SWITCH; J. M. Cronin, Boston, Mass. Application filed September 22, 1894. A double switch having movable members, and an auxiliary controller adapted to be brought in contact with the movable members by operation of the handle.

530,482. ELECTRIC RAILWAY SUPPLY SYSTEM; J. J. Green, Boonton, N. J. Application filed August 21, 1893. This comprises a box, hollow detachable insulating piece therein, a rock shaft extending into the box and carrying a contact lying within the insulating piece, a contact on the inner wall of the insulating piece against which the first named contact works, and means for operating the shaft from the exterior of the box to close the contacts.

530,485. PRIMARY BATTERY; C. J. Hubbell, New York, N. Y. Application filed April 30, 1894. The combination of a primary battery and porous cup, of a reservoir secured thereabove and having a receiving chamber for the fumes and a chamber for the absorbing agent, the chambers being communicating.

The Electrical World.

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CONTENTS.

BERLINER TELEPHONE PATENT.

The decision in the suit for the annulment of the Berliner microphone patent was handed down in the United States Circuit Court at Boston on Tuesday, December 16. The court decided the patent to be void. The decision is one of great importance as it leaves the telephone field free practically so far as the manufacture and transmitters and receivers is concerned. Had the Bell Company won the suit, it would have secured to itself for a long period of years the continuation of the monopoly of all long distance work. The question not only affects the Berliner patent and the telephone interests, but those who follow the suit will remember that it developed into an indictment of the Patent Office itself, and it is to be hoped that in these days of investigation and reform some good may result from the publicity thus given to the methods of so important a branch of the Government.

STORAGE BATTERY PATENTS.

An official announcement has finally been made by The Electric Storage Battery Company of Philadelphia in regard to the acquirement by it from various sources of the fundamental storage battery patents. As foreshadowed in these columns last week, there is no consolidation of the various interests of the storage battery companies concerned as has been erroneously stated, though the resulting situation is such that there will undoubtedly be a friendly coöperation in the future. The deal consisted in the transfer to the Electric Storage Battery Company of all the patents and patent rights relating to the manufacture of storage batteries that were held by the General Electric, Edison Electric Light, Thomson-Houston Electric, Brush Electric and Accumulator, Consolidated Electric Storage Battery and General Electric Launch Companies. This carries with it the sole right to supply in the United States electric storage batteries of the various important types heretofore developed and includes the protection of the several important decisions rendered in the United States Courts in interpretation of electric storage battery patents. The acquisition of these patents will, therefore, not only terminate the litigation which has heretofore had such deplorable results, but as all of the fundamental patents on storage batteries seem to be now included under one ownership, there is consequently a good prospect that the industry will have the free development which has been denied it in the past. The business methods employed in the past by the company now in control in its management of the chloride battery have been of such a character as to lend further assurance of the accomplishment of this long-deferred hope.

RECORDING MEASURING INSTRUMENTS.

Our esteemed London contemporary, *The Electrical Review*, in the current issue argues in favor of recording testing instruments, and wonders why practical forms of such apparatus have not been brought out. Every one who has done any testing will sympathize with the desire expressed for recording volt, ampere and watt meters for general testing use, but a still greater need is to induce managers of central stations to favor continuous recording instruments for commercial purposes. If investigators do not have recording instruments they will nevertheless manage, though perhaps, with much labor, to obtain satisfactory data, but this is not true as a rule of station managers. One of the results is a general ignorance of the unit cost of operation, and therefore of the knowledge upon which to intelligently judge as to economical or efficient working. It is not sufficient in a central station to require the keeping of a log to include readings of the voltage and current; it is too much to expect that employees will incriminate

themselves or friends by absolutely exact records of the former and the latter cannot approach continuous records in reliability and convenience. Every central station should have a recording voltmeter as a check on employees and a recording meter for the out-put—preferably a wattmeter. In power-houses there is an absolute necessity for a watt-meter if an intelligent check is to be kept on economy of operation, and if they are now only used in isolated cases it is probably due to difficulty in obtaining suitable ones for large stations. We think that a good commercial field is here offered to manufacturers, for the utility of recording instruments in the instances named could, without much difficulty, be impressed upon the managers of central and power stations, and no particular effort, as far as we know, has been thus far made to do this. The letter of Mr. Balch in another column reflects the opinion of intelligent managers, whose desires do not seem as yet to have met with the usual response from commercial sources.

ROTARY FIELD MOTORS.

In an article on "Notes on Rotatory Field Motors", which we reprint elsewhere in this issue, Prof. S. P. Thompson renders another of the services to the electrical public which it has lea ned to expect from him when a new electrical subject beset with difficulties comes to the front. His statement of the theory of the induction motor is not only simple and clear, but couched in terms that correlate it with the well understood theory of the continuous current motor. We think that perhaps if the succession of transformer and motor actions had been explained at greater length, the subject might have been made still clearer. In this connection the simple sketch and explanation due to Mr. Rankin Kennedy, is very effective, which shows how in a two-phased induction motor one of two currents differing in phase induces a current in the closed circuit winding, which current in turn is acted upon by the other pole, producing torque as in a continuous current motor, and vice versa. The explanation given of the way a resistance in the rotor circuit at starting will increase the torque does not seem to us to make the matter as clear as was evidently intended. In the discussion on Lieut. Reber's Institute paper on two and three phased motors, Prof. Pupin referred to this question, and as his method of regarding it supplements that of Prof. Thompson, we will briefly resume it. Starting out with the fact that the torque of the induction motor at any moment depends on the respective values of the currents in the armature and in the field and also on their difference in phase, it follows, that is, if the difference of phase is great, the torque may be small even if large currents flow; this difference in phase in induction motors is produced by self-induction, which may be greatest when the armature is at rest, but if the variation in phase of the armature current can then be reduced by any means the torque will be increased. There are three ways by means of which this can be done—varying the self-induction, resistance or capacity; of these the first is out of the question, and the second, being simpler than the third, is the one adopted. It will be seen that the resistance put in circuit is not primarily to stop the great rush of current, though it has that effect.

DIRECT CONVERSION OF COAL INTO ELECTRICAL ENERGY.

In our issue of July 21st we referred to the statement of Ostwald that the one essential lacking to produce electrical energy by the direct oxidation of coal without heat, is a suitable electrolyte to interpose between the carbon at one end of a cell and the oxygen at the other, which will itself suffer no change while permitting the necessary interactions. In a recent paper, abstracted in the Digest, December 8, Dr. Borchers, a German electro chemist, describes some investigations along the lines laid down by Ostwald. The idea in view was to produce electrical energy by the oxidation in the cold of carbon monoxide by means of atmospheric oxygen, the operation being conducted with cupreous chloride as an intermediary fulfilling the conditions above laid down. The apparatus constructed is equivalent to a gas battery having oxygen and carbon monoxide as the active materials and a solution of cupreous chloride as the electrolyte connecting them, though in one case powdered coal was substituted for the monoxide with theoretical results but little inferior to those obtained with the gas, though the practical difficulties involved in its use, were found to be much greater. With the crude apparatus used, an efficiency of 25 to 33 per cent. was obtained, or three times that of the steam engine; it should be added, however, that the internal reactance of the apparatus was so great that but little of the electrical energy was available for use in an exterior circuit. Dr. Borcher's points that a previous gasification of coal is necessary from practical considerations, and that various substances, such as the salts of iron, manganese, cobalt and lead, may also be employed as electrolytes. The conclusion of Dr. Borcher is that, whatever the outlook for the direct utilization of the energy of coal may be, it is at least evident that, by the present method, combustion in the cold can be effected of natural and artificial products of distillation and limited combustion (as natural gas, coke-oven gas coal gas, producer gas of all kinds and blast furnace gas), with the production of electrical energy. Assuming that the problem were really solved, it does not follow, as often asserted, that a revolution in the electrical industry would result. Supposing that the cost of the apparatus and labor were the same as with the steam and electrical machinery displaced, the saving would merely be in fuel, and this item at present, on the basis of four pounds of coal per hourly horse-power, amounts to less than one cent, with coal at $4.00 per ton, per hourly horse-power of electrical energy delivered, the total cost of which quantity of energy is rarely below 8 cents, and is usually sold for electric lighting at 12 cents. If, therefore, the fuel were supplied under these conditions for nothing, and used at an efficiency of 100 per cent., the reduction on the cost of electrical energy to the consumer would not be ten per cent. In the production of electrical energy it should be borne in mind that the fuel is but one item of cost in many, the total including fixed charges, management, superintendence, labor, depreciation, insurance and repairs. The error of regarding only the item of fuel has also led to the popular misconception as to the possibilities of water power as a source of very cheap electrical power. In this case it may easily happen that the saving effected in fuel, labor and machinery is balanced by the charges on the investment for improving the water power, though in most instances, particularly where the water power is an extensive one, favorably situated and not requiring too large an outlay for development, there will be a sufficient saving to justify its use, though it may not result in any notable cheapening of the cost of electrical energy to the consumer. Since writing the above we have received an interesting communication from Mr. C. J. Reed, printed in another column, which attacks the conclusion of Dr. Borchers that cupreous oxide fulfills the conditions of the electrolyte as laid down by Ostwald.

Decimal System of Weights and Measures.

The new Decimal Association of Great Britain, which has been established to promote the adoption of a decimal system of weights, measures, and coinage in the United Kingdom, met recently at the offices of the London Chamber of Commerce, with a large number of distinguished gentleman in attendance. Sir Samuel Montague, M. P., the chairman, mentioned that the association proposed to confine the present movement to weights and measures, and not deal with the subject of decimals in money. Sir Albert K. Rollit, M. P., proposed the following resolution: "That this association learns with satisfaction that the government consents to the appointment of a select committee to inquire whether any and what changes in the present system of weights and measures should be adopted, and the executive committee is hereby authorized to take such steps as it may consider best for promoting the adoption of the metric weights and measures." The motion was seconded by Mr. J. Emerson Dowson, C. E., and after it had been supported by half a dozen speakers, was carried. A further resolution was passed to the effect that the Hon. William L. Wilson should be informed of the present position of the movement in Great Britain for adopting the metric weights and measures, and that he be invited to use his influence to secure such legislation as may provide for the adoption of this system of weights and measures in the United States.—London *Electrical Engineer*.

Electricity Direct from Fuel.

BY C. J. REED.

The recent experiments of Dr. W. Borchers on the direct production of electricity from fuel gases, described in THE ELECTRICAL WORLD Digest of Dec. 8, are not as hopeful as one might think from the erroneous conclusions which Dr. Borchers has drawn from his experiments.

While the doctor is undoubtedly working in the right direction, he has in the experiments described accomplished absolutely nothing. If the doctor will carefully analyize the materials he employs and the products he obtains, he will make another startling discovery. He will discover:

1. That the increase in weight of his copper tubes is due to the formation of a coating of insoluble cuprous chloride, $Cu_2\ Cl_2$, produced by corrosion of the copper tubes.

2. That the oxygen absorbed by the cuprous chloride solution does not combine at all with the carbon monoxide or other fuel gases, but is used solely in oxidizing the cuprous to cupric chloride according to the following equation.

$$\underset{\text{Cuprous Chloride}}{O + Cu_2\ Cl_2} + 2H\ Cl = \underset{\text{Cupric Chloride}}{2Cu\ Cl_2} + H_2\ O.$$

The ultimate and only product of the reaction is cupric chloride produced at the expense of the copper tubes.

3. That the energy evolved as electric current is due to this corrosion of the copper tubes and to nothing else.

4. That the same results would have been obtained by his apparatus if he had not used any gases at all.

If the reactions supposed by the doctor to have taken place did actually occur, they would occur in the same manner with both electrodes of carbon and there would be a continuous evolution of carbon dioxide.

Even if the reaction did actually take place, the arrangement would be of no practical value, as the cuprous chloride, $Cu_2\ Cl_2$, rapidly change in the presence of air *by the absorption of oxygen* to cupric chloride, $Cu\ Cl_2$. which would have to be continually reduced by metallic copper or an equivalent reducing agent. In that case an ordinary zinc primary battery is more economical than a copper battery.

The writer tried about a year ago the same experiments described by Dr. Borchers, using carbon tubes for both electrodes instead of copper. Over one hundred different solutions, including cuprous chloride, were tried as electrolytes. I was unable to find that any two gases would combine spontaneously under these conditions unless they were capable of combining spontaneously at low temperatures when brought in contact with each other in the gaseous state.

Electrolytic gases formed at the electrodes by an electric current will recombine. But I was unable to get positive evidence of combination of even oxygen and hydrogen obtained from other sources and free from ozone and other impurities.

Dr. Borchers' Gas Battery: A Suggestion.*

BY LEGH S. POWELL.

Dr. Borcher's recently described experiments on the direct conversion of carbonaceous fuel into electrical energy are most interesting. In this connection it occurs to me to be worth while suggesting, through your medium, that the carbon electrode which is exposed to the air might very probably be rendered more efficient in performing its allotted work if it be exposed for a short time to a red heat in presence of air, so as to slightly burn its surface. The following experience leads me to make the suggestion:

Some twelve or thirteen years ago whilst amusing myself with making home-made batteries, I made the discovery that an excellent depolarising electrode might be made by filling a muslin bag with ordinary fire-grate cinders, placing a stick of arc carbon in the middle to serve as a terminal, and finally binding the whole tightly together with a string or elastic. Such an electrode when placed in common salt and water, with a strip of sheet zinc in proximity, will ring a bell continuously for days and weeks. But, it is significant to mention, if bits of coke or any other form of carbon (not previously exposed to a red heat in air) be substituted for the cinders, the electrical effect obtained under the same conditions of quantity, size, etc., is poor in the extreme. The effect obtained with different descriptions of carbon varies, that with coke being especially poor, whilst the carbon obtained by "baking" cocoanut shells answers much better; but nothing approaches that obtained with common grey cinders, whether produced from either coal or coke. In the case of coke, there seems to be a badly conducting film covering the true carbon, and the same is the case with carbon rods, which should be either scraped or have the surface burnt before introducing into the bag of cinders.

The cause of the remarkable difference in the behavior of burnt and unburnt carbon was at first thought to be due to the reduction of some oxides which had been formed during the burning, and that the action was similar to the Leclanche principle. But I soon satisfied myself that the real cause of the difference was principally, if not entirely, due to the simple circumstance of an increased superficial area. Not only is the indifferently conducting film on the surface of the carbon removed by burning, but it is obvious that the probing action of the heated air into the pores of the substance must lay bare and render accessible to the electrolyte a vastly increased quantity of carbon to that originally presented. The hydrogen deposited by the electric action will thus become distributed over a considerable area, and be more readily burnt up by the occluded oxygen in the carbon. That this is the explanation may be prettily demonstrated by taking two exactly similar sticks of arc carbon—a form of carbon in which metallic impurities cannot be called into question. Expose one of them for a short time to a red heat in a blow-pipe or in a fire, and scrape the other with a file. Then make up two similar cells of salt and water, and zinc strips. Each of the diminutive cells will ring a bell at the start, but the one which has not been heated will cease to ring it in about 15 or 30 seconds, whereas with the other the bell will go on ringing for two or three minutes. When run down the battery will recover its strength by a period of repose, and, as might be expected, the recovery in the case of a burnt carbon takes place much more slowly than with the unburnt, for the quantity of hydrogen to be consumed in the former is naturally greater than in the latter. This latter circumstance also goes to prove that extent of surface is the main feature at work rather than some special property of occluding or consuming the gases. It may be mentioned, however, that in a rough experiment made with a burnt and an unburnt plate of carbon used in a bichromate cell, no appreciable difference in efficiency was observed. The conditions here, however, are materially different. For the salt and water cell, or other similar electrolyte, there is every reason to believe that the hydrogen appearing on the carbon is consumed at the expnese of oxygen occluded from the air by that susbtance, and that the action does not appertain to the Smeed type of cell. Therefore, as stated at the outset, it is quite possible that for the purposes of Dr. Borcher's fuel battery the plan of increasing the interstitial carbon surface by the simple means described may prove to be advantageous.

Might not a further improvement in electrical effect be perhaps obtained by applying pressure to the respective gases used? I have long wanted to try the effect of pressure of air and oxygen on my cinder battery, to see if there was an improvement in constancy and output, but have never had the time and opportunity to try the experiment.

*From the London *Electrical Review*.

Fly-Wheel Accidents—II.

BY W. STUART-SMITH.

To determine whether the bending moment acting in the middle of the span is sufficient to cause rupture, it is necessary to consider the *moment of resistance* or the maximum strain which any given section is capable of withstanding. The outer layers of the rim will be lengthened and the inner layers shortened under the bending action; hence rupture will take place by tearing apart the outer layers and crushing the inner layers, while along the neutral plane the force will be shearing only and acting at 45 per cent. This is of no importance under the circumstances. The resistance of the material to rupture will be greater than the tensile strength and less then the resistance to crushing, the exact amount depending upon whether the greater portion of the section is to be ruptured by tearing or crushing, and this in turn depends upon the figure or shape of the section. For a rectangular solid section, the metal of which has a tensile strength of about 20,000 pounds, the modulus of rupture for cross breaking will be about 40,000 pounds. The moment of resistance to cross breaking is in general expressed by $M = ufbh^2$. Where f is the modulus of rupture, b is the breadth and h the depth, u is a factor depending upon the shape of the section; it has a value of one-sixth for a rectangle. These formulæ for maximum bending moment and moment of resistance are easily deduced and their origin need not be considered here.

With the data now at hand it is easy to determine at what speed the wheel assumed must be driven (provided it is perfect in all parts) in order that it may be destroyed by centrifugal force. The moment of resistance $= ufbh^2 = 1\text{-}6 \times 40{,}000 \times 50 \times 3.5^2$ (all dimensions being expressed in inches) $= 4{,}083{,}333$ inch pounds.

The maximum bending moment has been shown to be 438,900 inch pounds, hence to wreck the wheel the centrifugal force must be increased $\frac{4{,}083{,}333}{438{,}900} = 9.3$ times, which (since centrifugal force increases as the square of the speed) means that the wheel will be wrecked if the speed comes to three times its normal value. As wheels are never perfect and may contain blow holes or be spongy in the middle of the span, wrecking would generally occur at a considerably smaller speed than this.

The above is on the assumption that the arms are strong enough to furnish rigid supports that cannot give way under any stresses that may be placed upon the spans. If this is not the case, and the arms are liable to give way, the speed required for destruction will be much reduced, and an examination of this question will be in order.

Consider the part of the rim included between three areas. The curvature will not be so great but that the formula for greater bending moment for a straight span will apply with some degree of approximation. The span will then be of double the length and the arm in the center will act as a tie resisting the bending of the span. The length of span being doubled and the centrifugal force being doubled, the greatest bending moment will be increased four times and its point of application will be at the tie. It is evident then that the tie (*i. e.*, the arm) will be subjected to a considerable tensile strain, and its tensile strength must be added to the moment of resistance of the rim in order to determine the total resistance to rupture at this point. Assuming the least section of the arm to be 48 sq. in. and the tensile strength 20.000 pounds per square inch, the total strength of the arm will be 960,000 pounds. This, added to the moment of resistance to cross breaking will give a total of 5,043,333

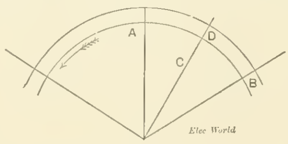


Fig. 2.

inch pounds. The bending moment being four times that previously found will be 1,755,600 inch pounds, and consequently the ultimate strength of the rim and arm is but 2.9 times the working strain normally thrown upon it. Certainly a small factor of safety and one overcome by a speed of 1.7 times the normal. As the consideration of one span only gave a factor of safety of 9 it is evident that when a wheel is worked by centrifugal force the inertial break may be expected to occur at the smallest part of an arm, and that this will be followed by a fracture of the rim immediately alongside the stump of the arm left on the rim. The fracture of the rim will occur at that point, because the bending moment will here be nearly at a maximum, and the moment of resistance much less than through the thicker metal at the point of exact maximum bending moment.

From these considerations it should be easy to determine by a post mortem examination whether or not the wheel was wrecked by centrifugal action.

If the arms have but 24 inches cross section instead of 48, as assumed above, the ultimate strength will only be reduced from 2.8 to 2.6. and it is evident that it is only necessary to put in the arms as much metal as is required for driving, and to increase the resistance to centrifugal force by increasing the thickness of the rim. Retaining a rectangular section, doubling the thickness of rim will double the centrifugal force and the bending moment, but it will increase the moment of resistance four times, since this varies as the depth squared. Also with a given weight of rim the strength will be increased by using a T section, thereby increasing the depth.

If from some flaw in the rim it breaks between two arms, the conditions will be changed and the remainder of the span now becomes a beam supported at one end and uniformly loaded, with the greatest bending moment near the arm. If this piece does not break off, the beam may be considered as extending forward o the next arm, and the resulting span will have a great leverage and a tie near the outer end. The result will be a strong tendency to break the arm by tensile strain at the smallest section. This arm being thus broken the same might happen to the next, etc., the rim in the meantime breaking into pieces as the arms broke and increased the leverage on the rim. This would account for such a case as that mentioned by Prof. Flather, where all the arms of a wrecked wheel were found to be broken close to the rim.

Where a wheel is running at speed (and performing the office of a fly-wheel only) there is practically no transverse strain on the arms. The rim is subjected to shearing and cross breaking strains (but no tensile strains), and the arms to tensile strains small in amount normally, but very severe when the speed is such that the moment of resistance of the rim is nearly reached.

When the wheel is at the same time a fly wheel and a driver, the conditions are very different and the stresses much more complicated. The arms and rims are subjected to the same strains from the action of centrifugal force, and in addition the arms are subjected to a transverse strain due to the driving force being transmitted through them. Those portions of the rim not under the driving belt are subjected to the full force of the centrifugal action, but when they pass under the belt this is largely neutralized by the belt pull, which tends to collapse the wheel. The centrifugal force may be entirely overcrome by this and the load on the rim instead of being from within it may be from without or practically zero in either direction; then an instant later the action will be from within, and this applying and removing of the load will occur 100 times per minute with a working of the rim back and forth. It is needless to say how much more severe these strains will be than would be the case if the load was continually applied. Thus from this c use alone a fly-wheel acting as a driver is far more severely strained than would be the same wheel acting as a fly-wheel only. But this is not all. In addition to the bending moment, which was shown above to be constantly acting on the spans, the driving force will produce a further bending moment tending to break the wheel at the same point as that due to centrifugal force. This is easily shown. Let A, B and D, Fig. 2, be three adjacent arms. With the wheel moving in the direction of the arrow the power applied to arm at B would be transmitted to A through the curved arch of the wheel and hence at the middle arm D the binding moment due to the driving power transmitted from arm B will be the pressure at B, multiplied by the arm CD, or the height of the arch of the neutral layer of the rim. This will be applied at D in precisely the same manner as the bending moment due to centrifugal action and must be added to it to get the total bending moment. The amount of this increased bending moment is readily calculated for any given wheel. To determine the pressure acting at B it is not sufficient to use the horse-power transmitted by its wheel. That would give the average pressure from which would be obtained the average bending moment, but it is the maximum bending moment that is effective and this is to be obtained by using the pressure at B, when the engine is exerting its maximum turning effort.

The data which was assumed in the previous calculations are very close to those of an actual working wheel, and it was seen then that increasing the speed 60 per cent. would be sufficient to break the wheel if it was perfect in its construction (not necessarily in design), *i. e.*, had no blow holes, was not spongy, had no shrinkage strains, etc. When it is seen in addition how much more excessive the strains will be when the wheel is used as a driver, the fact will be appreciated that many wheels are working just within the limit of safety and it will not seem surprising that they go to pieces. Many wheels must be working within such narrow limits that the variations of load will so weaken them that they may go to pieces under ordinary working conditions and not even the assumption of an application of a shock or increase of speed is required when seeking for an explanation.

This article deals only with strains, the amounts and methods of application of which can be easily predetermined and points out how the rims must be modified to enable a given amount of material to offer the greatest resistance. Wheels have in addition many accidental weaknesses, but they have been so thoroughly considered in the excellent paper by Prof. Flather that nothing need be said about them except that it is scarcely possible to guard against all of them, and they must be allowed for by extra factors of safety and a change in the material used in construction.

Electricity from Water Power.

In Switzerland 52 per cent. of the electric generators are driven by water power; as coal is expensive there and water power is cheap, this ratio will doubtless become still greater.

EVERYTHING along the avenues of trade is redolent of the pirit of Christmas tide. The signs of the times, and of course they are electric signs, show that the great day is at hand. On house tops, on store fronts, in the theatres, in the churches, the glow of the incandescent lamp is to be seen, spelling out names and legends, or forming queer devices and decorations. New York, particularly, is outshining herself this year. It certainly is a triumph in decorative effect. That suggestive locality—sacred to Pantatas—the Tenderloin, is bright enough at all times, but just now it fairly reeks of light. Looking southward along Broadway from the "L" station at Thirty-third street, innummerable specks and streaks oj flame shine out as though it were meant to be the route of a great truimphal procession.

Many of the signs are permanent arrangements, of course, but many more have been erected in honor of the holiday season. Tha section known as the shopping district is especially attractive in window shows whose best drawing card is their electrical effects. Electric toys are on sale in the toy shops, Christmas plays with electric effects are to be seen in the theatres, and in fact there seems be a decided and general adoption of the current as a means of furthering the season's cheer.

Of all the special Christmas decorations there is none perhaps which goes so far into expensive elaborations of detail as that of H. C. F. Koch & Co., on 125th street. It was brought to perfection under the direction of Mr. F. W. Campbell, who signs himself the "champion window artist of New York and Brooklyn." Koch & Co. make a specialty of handkerchiefs, and these are made the background for the series of views on exhibition. There are 7,676 'kerchiefs in the window and they make a particularly snowy looking frame which sets well with the season. There are thirteen scenes. The central and largest is the Trocadero Palace, of Paris, done in miniature. The magnificient water stairway is admirably reproduced. The statuary is the same as the original, with one exception—a large bronze Goddess of Liberty stands in the centre of the scene. Streams of water start from the statues, from pipes and jets. They cross and recross each other and roll down the stairway and over the stones shining and glistening from the light of miniature incandescent lamps. The tall columns of the Trocadero show off well behind the water foreground oı through the central fountain, which is a real McMonnie in pattern.

One scene represents a storm at sea. There is a wreck and the life-savers are at work. On shore is a small-sized lighthouse with an imitation revolving light which flashes out at regular intervals. The tenement house fire scene gives scope for some nice little electrical effects. By means of colored globes and an automatic interrupter the fire becomes quite lurid and the hose company at work quite realistic.

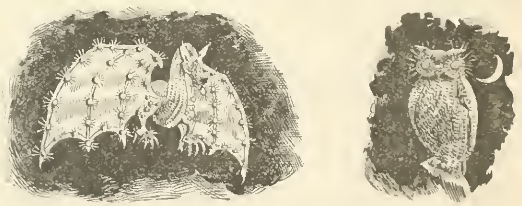
"Dante's Inferno" is also well equipped from the electrical standpoint. Perhaps it is not an exact representation of the place where the great poet sent many of his enemies, but it takes with the "gallery," which, in this case, is the sidewalk, and when the light flashes through its gloomy caverns, makes a great hit. So does the "Druid's Temple," from Killarney Lakes, which is lighted with miniature lamps so as to give a moon effect. "Niagara Falls" is represented with real water flowing over the precipice and lighted from behind. It is quite realistic. There are two scenes from Rip Van Winkle, one where Rip meets the dwarfs and one where he awakes from his long sleep. Van Cortlandt Park on a winter night is represented covered with skating parties. There is an "Eastern war scene," a "private deer park" and a view of the West Point parade ground, surrounde l by water, on which sail the caravels of Christopher Columbus. Still another scene represents icebergs near Kosoak.

The whole display cost in the neighborhood of $2,000. The electrical part of it was constructed by Mr. R. Kyle, the resident electrician. The wires are all covered with rubber tubing. The temporary equipment of the window consists of 50 lamps (Edison 16-cp) divided into 16 footlights, 10 border-lights and the remainder within the spaces to add to the scenic lighting effects. Messrs. Koch & Co. have a T.-H. plant of their own with a capacity of 1,200 lights. There is also a chloride accumulator installation of 78 cells, which is used at night when the place is being cleaned and the ordinary power is cut off.

Williams & Co., at Third avenue and 125th street, also have a window Christmas scene in which Kris Kringle plays a prominent part. The old gentleman's workshop is lighted with incandescent lamps, as is also the house down whose chimney he disappears from the view of the crowd of children on the sidewalk. The Manhattan Electric Company has the contract for lighting his abode.

Macy & Co., at 14th street and Sixth avenue, exhibit a panorama showing all the wonders of the Arabian Nights. The figures are in wax and move on a platform. The lighting effects are obtained from the permanent plant.

A collossal figure of Santa Claus, Kris Kringle, or St. Nicholas, whichever you may like to call him, stands exposed on a balcony of Madison Square Garden, and serves to advertise the "Toy Fair in Nuremberg" now running in the Garden. Even his eyes are lamps and they also act as the buttons on his coat. He has two big Christmas trees with him studded with 32-cp lamps, while in front of him is a powerful reflector and several 32-cp lamps, which serve for general illumination. He is a pleasant foretaste of the sights the children see inside. There is an intent look in his electric eyes which gaze off through Madison Square. Perhaps it is caused by an immense flaming legend which covers the side of a house at the southward—"Paul Jones' Pure Rye Has No Equal." This sign used to tell of building lots that were swept "by ocean breezes." It is the largest electric sign in town.



Seen on Broadway.

The "Brownies" at the Fourteenth Street Theatre furnishes abundant opportunity for electric effects. The attraction is in large measure spectacular and like all spectacular productions depends mostly for its lighting effects on electricity. Brownieland is a new domain and almost any innovation in the stage effects of the play becomes legitimate. Outside of the regular effects, the productiou has several new contrivances. In the first act is a scene in which the Brownies are represented adrift on a raft in mid-ocean. A terrible storm is raging. The little people have gone to the rescue of their Queen, who has been spirited away by the wicked demon Dragonfel. In the midst of their trials a terrible sea serpent. with eyes and mouth of fire appears and threatens to devour the whole band. At the critical moment, Neptune, the god of the sea, arises, quiets the waves and saves them. Neptune, of course, appears riding on his traditional sea shell, and by means of the calcium and

several bunches of electric lights behind and in the shell his appearance is made very effective. The sea-serpent's eyes are made of 16-cp blue lamps, while a 16-cp red lamp makes a very vivid and fiery tongue.

The Brownies finally land on the enchanted island of Dragonfel. The scene is one of the prettiest in the play. The castle is in the natural rock formation and reminds one of Gibraltar. The niches, windows and crannies in the rock shine through the darkness, for it is night, and the Brownies are on shore playing a serenade to the moon on illuminated mandolins. From a large branch of a tree hangs a line of enormous apples. Eyes, a nose, and a mouth, are cut in each, and lamps inside light them up at intervals. A solitary owl with blinking, incandescent eyes, guards the serenading of one or two candle-power. The mandolins have a 16-cp lamp inside and trailing wires to each allow the players to walk around at will. The moon, which is on a flat, is lighted from bunches. Finally the man in the moon gets tired and goes to sleep. A night-cap with *Good-Night* shining on it begins to appear on his head and he sinks on the horizon and finally disappears.

The interior of Dragonfel's castle is a marvel of scenic effects, and so is the scene when the castle is destroyed by volcanic eruption, but the "Jeweled Mines" scene has more real electrical effect in it. The walls of the mine are made of tinsel paper and cloth, and besides are covered with metallic protuberances that reflect a great deal of light. At various points the walls are studded with "jewels"

Details of a Harlem Show Window Decoration.

band whose efforts are so rewarded that the man in the moon speaks to them and guides them in their search for the princess. The mechanical arrangements are simple. The castle is lighted by bunches of lamps from behind. The apples five in number, have, as intimated, a 16-cp lamp inside. The owl's eyes, which are "winked" by snapping a switch at the board, are miniature lamps made of colored glass. Back of these little windows are powerful bunch lights which project gleams of light through the jewels is a very realistic manner. At various points on the front of the walls are red, blue and white lamps in miniature. They look like jewels and add much to the general effect. The Edison system is used, each section of scenery being plugged on to a socket in the stage

floor. The flashing is done at the switchboard by snapping the bunches in and out.

The last scene in the play shows a night in Brownieland, with "blossoming of the Moon-flower and Night-blooming Cereus." An "Aerial ballet" is also shown, in which some of the dancers actually move around in air. The scene shows a glen. There is a waterfall and stream, and running water with miraculous flowers blooming by the side of the brook. The running water and the waterfall are made with an ordinary "ripple" on a flat scene with concentrated bunches behind. The Moon-flower has lamps concealed within it, and as it blossoms the leaves turn back and the stamens in the form of filament lamps rise out of it. Lamps are concealed in the shrubbery and among the rocks and a row of lamps in a pool of still water makes the latter very effective. In the "aerial ballet" the dancers are suspended from above on wires. The lighting effects are obtained by means of four arc "calcium" lights—two in the orchestra and two in the wings. Transparencies in front of these allow of various combinations of colors to be thrown on the girls' dresses. Mr. R. H. Francis is the electrician in charge. The theatre has an Edison switchboard

AT MADISON SQUARE GARDEN.

and current is obtained from the street circuit. The production shows how necessary electricity has become to the spectacular play.

By far the biggest theatrical attraction of the year has been the "Living Pictures" at Koster & Bial's. And if any one thing in the theatrical line has depended on electricity more than another for its production, it is these living pictures. As nearly all the world has seen them by this time, only the Christmas element in them needs mentioning. Koster & Bial have put on a seasonable picture in the form of a reproduction of the famous "Christmas Eve" by Operti. It will doubtless be very much admired, as the original is well known, and resident electrician Charles Meulenbergh will have added another to his triumphs in electrical lighting.

The Church of St. Francis Xavier, on 16th street, is, electrically speaking, one of the most elaborately lighted churches in the world. The Italian Renaissance style of architecture is well adapted to electrical decoration. There are nearly three thousand lamps scattered over the church edifice. The altars are covered with decorative effects, symbolical and otherwise; around the sides of the church are all kinds of devices composed of lamps; the statuary is lighted electrically; the pulpit has its equipment and altogether the Order of Jesuits seems to have departed very far from its professed simplicity of method and purpose when it allowed its church to be so elaborately equipped. It is only on stated occasions that the church is completely lighted, but at Christmas time every lamp will be on, and several special devices will be used. The most beautiful device in the church to be used this Christmas is the lighted column and vase of lilies. The column is of alabaster, three feet high and one foot in diameter. It is hollow and on it stands an alabaster vase with porcelain lilies springing from it. Incandescent lamps form the stamens of the lilies and in the

THE FIERY DRAGON—FROM "THE BROWNIES."

vase and the column are concentrated bunches of lamps. When the current is turned on, the lilies and vase and column light up, showing all the tints and veins in the stone. The decorations were designed and installed by Mr. D. Colombani, formerly connected with the Edison Electric Illuminating Company.

New York is rapidly becoming a tower lighted city. A view from the roof of a tall building discloses a large number of illuminated steeples and cupolas shining up through the darkness. Some are permanent effects, others have been equipped as holiday attractions. One of the prettiest which will be lighted on Christmas night, is on Geo. Ehret's Hell Gate Brewery on the upper east side. It is a pointed tower and from the apex to the base are strung four long rows of 16-cp incandescent lamps. On each side of the tower the

THE ENCHANTED ISLAND—FROM "THE BROWNIES."

monogram of the firm shines out. The figures 1866—1894 on the front of the building, show how long the firm has been in existence. On the top of the tower is an eagle which serves for a weathervane. In the eagle's mouth is a 50-cp lamp. A sliding contact arrangement under the eagle allows the lamp to remain lighted although the bird turns with the wind. There are also four 50-cp lamps stationed just below the eagle. There are seven hundred and fifty 16-cp lamps on the tower. The generating plant

consists of two No. 16 Edison dynamos of 350 amperes capacity each. Everard's Brewery, on the Harlem River, also has an electrically equipped tower which will be illuminated during the holidays. The Everard clock is known far and wide and Harlemites always set their watches from its face. Of course the *World* dome will be lighted up, as Madison Square always is. As intimated Broadway is in a blaze of light and several temporary signs have been erected in front of the stores and theatres. The Empire Theatre has an immense arrangement done in opalescent Edison lamps which are made to spell "Masqueraders," the name of the play running there. At Abbey's, where Lillian Russell is singing, is another sign, a "written" arrangement, which tells that here is to be found the present "Queen of Brilliants." The American Theatre has two huge signs on the roof and two more over the doorways, and the Hotel Marlborough is similarly bedecked. At the new Herald Square, which used to be the Park, the words "Rob Roy" and "The Whitney Opera Company," stand out in light. The theatre itself is ablaze. Beneath the eaves of the roof is a row of apertures or cornices. Each one contains an opalescent lamp. The portico is similarly provided for and both rows extend completely around the building. In the middle of Herald Square stands the Herald Building. All around the edge of the roof stand the Herald owls—twenty-six night birds on guard, their eyes blinking out the hours and half hours. The eye of each owl is an incandescent lamp, the current to which is automatically interrupted with the stroke of the clock.

Koster and Bial spell their names with incandescent lamps and so does Fanny Davenport, who is playing "Gismonda" at the Fifth Avenue Theatre. The Standard Theatre and Hoyt's Madison Square follow suit. Augustin Daly has added a row of incandescent lamps to his theatre portico. "Old Hoss, Bill Hoey," shines out at the Bijou, and "Comstock's Minstrels," in hundreds of miniature incandescent lamps, is a feature in the decoration of St. James Hall.

The stores, too, have their decorations. Thorley, the florist, believes in the advantage of making a good show and intersperses his plants with incandescent lamps. His name, in large spencerian letters, in lamps, is above the door. Any one who passes Hilton, Hughes & Company's store will be pretty sure to stop and look twice at the wonders displayed in the windows, not because of the articles themselves, but because of the way in which they are set off. Here are probably the best lighted windows in town. The principle, or arrangement, of the lighting effect, is the best possible under the circumstances. Every object displayed rests under a perfect glare of light, yet not a lamp is to be seen. The hundreds of lamps in the windows are attached in rows around the edges, or more properly, back of the window frames, above and below, and at the sides.

In running up the list of electrical Christmas attractions one peculiar fact has been elicited. There is quite a demand for electrical toys, and while one or two playthings are sold, yet there is no really good electrical toy on the market. Toy dealers say that there would be a good sale for an attractive article but it is impossible for them to get one, because capable electricians will not give time to the invention of what is an apparently trivial object.

This about completes the list of Christmas attractions in electricity. The list is long enough, however, to show what a potent factor the electric current has become in furthering the season's cheer.

A Practical Method for Measuring Rapid Changes in Current.

BY WALTER E. HARRINGTON.

Frequently cases arise when it is desirable to know the current that flows in a circuit due to sudden changes in condition.

Ammeters never indicate and further cannot act as an index to sudden changes in current, as the movement of the needle depends upon a number of factors, viz: The moment of inertia of the needle and that of the pointer or moving system; the moment of the controlling force, that is, the forces which resist the needle moving away from zero position, and which tend to pull it back to that position; the moment of the forces that "damp" the vibrations, that is, the forces due to air or "magnetic friction" that simply resist the motion of the needle; lastly, the moment of the deflecting forces exerted on the needle by a given constant current flowing through the coil.

W. E. Ayrton gives as a practical formula to use with a ballistic galvanometer (such as is used for measuring sudden changes) the following:

$$K = \frac{P A \sin\left(\frac{a}{2}\right)}{\pi \tan a^1}$$

where K = number of coulombs that pass;
P = periodic time of vibration of needle;
A = amperes which flowing through the coil causes an angular deflection a';
a' = angular deflection of needle due to amperes flowing through the coil;
a = angular deflection due to discharge of K coulombs;
$\pi = 3.1416$.

This formula bristles with uncertainties, and with the formula given as a correction for "damping" we are still further ensbrouded in vague and uncertain darkness; the formula for correction for "damping" is

$$K = \frac{A P k}{2 \pi a^1}\left(1 + \frac{l}{2}\right)$$

where l is the "Naperian logarithic decrement."

When readings are taken of small values with fine and carefully calibrated instruments and great care is exercised, the ballistic galvanometer method is correct but exceedingly tedious.

The determination of instantaneous values of currents may be appreciated when we look up the literature of the subject. Dr. Bedell in a paper in the *Transactions* of the American Institute of Electrical Engineers, Oct. 1893, on "Hedgehog Transformers and Condensers" mentions some 20 investigators using an instantaneous contact method, among whom are such names as Joubert, Nichols, Morton, Ryan and Duncan.

Where many readings are to be taken of small currents or potential differences the method as described in "Notes on wiping contact methods for current and potential measurements" by Prof. B. F. Thomas in the *Transactions* of the American Institute of Electrical Engineers May, 1892, is unquestionably one of the most easily applied and rigorously correct of the methods practiced, as it is a "null method." Referring to the diagram, R is a resistance

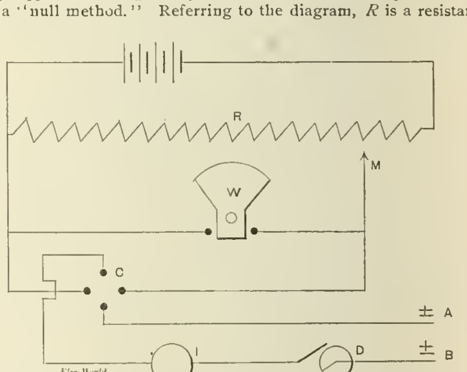


FIG. 86.—DIAGRAM OF E. M. F. INDUCED IN ARMATURE COIL.

of some convenient form, with which contact may be made with a movable terminal, M, or which may be varied between or beyond the terminals of a Weston voltmeter W. From these terminals wires lead through a commutator C, a sensative galvanometer or telephone I and the wiper D to any points A B, whose potential curve is desired. The whole being in operation and C properly placed, M or R (or both) is adjusted until I shows no current, when the potential difference existing at A B is read off directly in volts by the voltmeter W.

When it is desirable to read rapid flows of heavy currents, a method that is inexpensive and easily applied has been needed. The writer, after trying different methods finally adopted the following, owing to its simplicity and positiveness.

A magnetic circuit breaker was employed which could be sensitively adjusted to open on different currents within its range, and which could have its time element of opening the circuit inversely proportional to the current causing the opening.

By changing the adjustment of the magnetic circuit breaker until opened by the current, and also until not opened by the current, and by bringing these two points to two consecutive adjustment indications, they give a means for determining the current, as the current would lie between the two indications as obtained.

A magnetic circuit breaker was used by the writer giving an exceedingly fine range of adjustment, and which was very rapid in opening the circuit, thus obviating the vicious arcing attendant upon the opening of circuits with other forms of magnetic circuit breakers.

Notes on Rotatory Field Motors.*

BY SILVANUS P. THOMPSON.

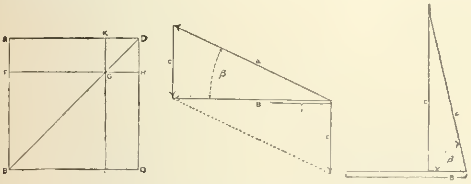
The following notes, compiled for the use of students at the Technical College, Finsbury, are printed as being probably of service to others in aiding their comprehension of the operation of this little understood class of machinery.

1. Elementary Theory of Rotatory Field Motors.

It is assumed that a rotatory magnetic field can be produced in known ways by the proper combination of polyphase currents, whether 2-phase or 3-phase. It is desired to know the relations between the speed of revolution of the magnetic field, the speed of the revolving part of the machine, the torque, and the efficiency of the machine.

Let Ω stand for angular speed of the rotatory magnetic field $= 2\pi\ n$ in a bipolar machine, or $= 2\ \pi\ n \div m$, where m is number of pairs of poles if the machine is multipolar; and n for the frequency of period.

Let ω stand for angular speed of the rotating part, or *rotor* of



FIGS. 1, 2 AND 3.

the machine, $= 2\pi\ n_2$, where n_2 is the actual number of turns per second; (or $2\ \pi\ n_2 \div m$ for a multipolar machine).

Let Q stand for the torque between the fixed part (or *stator*), and the turning part (or *rotor*).

Let W stand for the power (total watts) communicated by the stator to the rotor.

Let w stand for the power (useful watts) actually used in turning the rotor.

$\Omega-\omega$ is the *slip* of the rotor with respect to the field, or is the difference of their angular speeds. If the field has an angular speed $\Omega-\omega$ greater than that of the rotor, it is clear that the inductive action on the circuits of the rotor will be exactly the same as if the rotor were revolved backwards with a speed $\Omega-\omega$ while the field stood still.

$W-w$ is the power wasted in heating the conductors of the rotor, since it is the difference between the total power supplied to the rotor and the power it utilizes. Now W is proportional to Q and to Ω, and, therefore, by choosing suitable units may be written $W=\Omega$. And w is proportional to and $Q\,\omega$, and may be written $w=Q\ \omega$.

Hence, dividing the last equation by the preceding,

$$\frac{w}{W}=\frac{\omega}{\Omega}$$

From this we see that the efficiency of the rotor is the same as the ratio of the two speeds.

Further, the rotatory field motor is simply a sort of running transformer, of which the stator and rotor windings constitute respectively the primary and secondary. Now, if ω were made $=\Omega$ there would be no induced currents in the rotor conductors, the stator would then simply act as a choking coil; hence it follows that if the condition of supply of the primary currents is that of constant voltage, the magnetic flux through the machine, rotating with speed Ω, will have an approximately constant value at all loads, just as the flux in the core of an ordinary transformer has. Further, if there is very little magnetic leakage in the gap between stator and rotor (as is, indeed, the case in well-designed motors) neither the primary circuit nor the secondary circuit will have any appreciable self-induction, and the currents in the rotor conductors will be in phase with the electro-motive forces induced in them. Whence it results that the maximum currents in them will always occur when the conductors are in that part of the field where the flux density is a maximum. And as the flux is constant at all loads, it follows that the torque will be proportional to the currents in the rotor. But these are proportional to the slip $\Omega-\omega$; hence, also, it follows that Q will be proportional to $\Omega-\omega$, and may be written $Q=b\ (\Omega-\omega)$ where b is a constant depending on the strength of the field, the radius of the rotor, and the length and resistance of the conductors of the rotor.

*From the London *Electrician*.

We may now write:

$$\text{useful watts } w = b.\ \omega\ (\Omega - \omega);$$
$$\text{total watts } W = b.\ \Omega\ (\Omega - \omega);$$
$$\text{wasted watts } W - w = b.\ (\Omega - \omega)^2.$$

Hence we may at once apply the now well-known diagram of motor efficiencies, by drawing (Fig. 1) a square $A\ B\ C\ D$, having its side $A\ B$ numerically equal to Ω, and cutting off a piece, $B\ F$ equal to ω. The area $A\ F\ H\ D$ represents the total watts supplied, the area $A\ F\ G\ K$, or $G\ L\ C\ H$, the watts utilized, and the square, $K\ G\ H\ D$ the watts wasted in heating the conductors of the rotor. The efficiency will approach unity as F moves up toward A; and the output will be a maximum when $\omega = \frac{1}{2}\ \Omega$, the efficiency being then only 50 per cent.

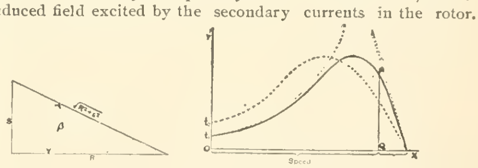
In good modern rotatory field motors, the slip is only, at the most, about 4 per cent., except for very small sizes of machine, where it may be 10 per cent. at full load.

In the above investigation no account has been taken of the loss due to heating in the conductors of the primary or stator circuit. This, like the ordinary $C^2\ R$ loss in the exciting circuit of any dynamo, is but a small percentage of the whole energy supplied. Neither has any account been taken of hysteresis losses in the iron of the stator, which also have to be supplied, as it were, by additional excitation, but are small in a well designed machine. Losses by hysteresis, or by eddy-currents in the iron of the rotor, will, like the friction of the journals, deduct from the available power, but these are necessarily very small since the reversals of magnetism in the rotor are proportional, not to Ω but to $\Omega - \omega$.

2. Resultant Magnetic Flux in Motor.

It was pointed out above, from consideration of transformer analogies, that the magnetic flux in the motor is of approximately constant value at all loads. Further, it can be shown to be a consequence from the law of hysteresis, that (in a bi-polar motor) the flux through the rotor core will be of approximately uniform density, and, therefore, that in the gap between rotor and stator it will be distributed with a density which varies as a sine function around the periphery from point to point, though constant at all loads, and rotating with speed Ω. Let the density of this flux in the direction in which it is a maximum be called $\mathfrak{B}$. This flux-density, like the flux-density in a transformer core, is the result of the magnetizing actions of both the primary and the secondary windings. Kapp has given a discussion of the reaction which may be summarized as follows:

Take a line, $\mathfrak{B}$, to represent (Fig. 2) the maximum of the flux-density in the motor; it may be considered as revolving around one end as a centre. This field is due to the joint action of the impressed field excited by the primary currents in the stator, and of the induced field excited by the secondary currents in the rotor.



FIGS. 4 AND 5.

These rotor currents are in phase with the resultant field (if there is no magnetic leakage), proportional to it, and to the slip. They tend to produce a cross-magnetizing reaction. They may be represented by a length, i, set off along the side $\mathfrak{B}$. This current i tends to produce a cross-magnetizing field proportional to itself. Let the line c at right angles to $\mathfrak{B}$ represent this cross field. Here $c = k\ i$ where k is a coefficient depending on construction. Complete the triangle $\mathfrak{B}\ c\ a$ by drawing the line a. Then a represents in magnitude and phase the magnetic field that must be impressed by the primary currents in the stator, since is the resultant of a and c.

Further, since the torque is proportional to both $\mathfrak{B}$ and i — that is to $\mathfrak{B}$ and c— the area of the triangle $a\ \mathfrak{B}\ c$ will represent the torque.

Moreover, since i is proportional to the slip, and to $\mathfrak{B}$, and to a constant depending inversely on the resistance R in the rotor circuit, we may write:

$$i = \frac{\mathfrak{B} \times \text{slip}}{R};$$

$$\text{or slip} = \frac{i\ R}{\mathfrak{B}};$$

and substituting $c \div k$ for i,

$$\text{slip} = \frac{c}{\mathfrak{B}} \times \frac{R}{k};$$

but $c \div \mathfrak{B}$ is $\tan\beta$, hence slip is proportional to $R\ \tan\beta$.

3. Conditions of Operation.

There are three chief stages of operation to be considered; and for the present we will consider the supply voltage constant, and the machine devoid of magnetic leakage.

(*i.*) *Starting.*—Here $\omega = 0$, and slip $= \Omega$. Rotor currents enormous, primary currents also enormous. Therefore, β the angle of phase-difference between primary currents and resultant field very large. Torque enormous if no magnetic leakage.

(*ii.*) *Running at Light Load.*—Here ω is very nearly equal to Ω; and as slip is small, rotor currents will be small, and their reaction small. Angle β will be small, and a will not be much larger than $\mathfrak{B}$.

(*iii.*) *Running with Heavy Load.*—Here $\Omega - \omega$, the slip, must be considerable enough to allow of the generation in the rotor of currents considerable enough to produce the necessary torque at the actual speed of rotation.

In addition to the above, if the speed is artificially brought up to synchronism by supplying from without power to overcome friction, etc., there will be no rotor currents and no torque. If the speed is artificially increased beyond this, so that the rotor runs faster than its field, power will be consumed in driving it, and it will act as a generator, pumping back current into the supply network, as pointed out by various writers.

4. Starting Torque if Impressed Field is Limited.

Suppose, now, that for any reason (notably in consequence of even a small amount of self-induction in either stator or rotor, such as would occur if there is any magnetic leakage) the impressed field a is limited in value. This will in fact be the case if even without interior self-induction or leakage the supply is not at constant voltage. Then, when, as at starting, the slip is great, the triangle $a\ \mathfrak{B}\ c$ will become of the form of Fig. 3; for if the slip is proportional to $R \tan \beta$, and R is small, $\tan \beta$ must be very great, or β will be near 90°, and the torque (represented by the area) will be very small. If we increase R we necessarily decrease $\tan \beta$, making $\mathfrak{B}$ greater and the area greater, and so get a greater starting torque. This is why introducing a non-inductive resistance into the rotor circuit at starting enables the machine to start with a greater torque.

5. Relation Between Torque and Slip.

In order to get an equation for the torque in terms of the slip, and the resistance of the rotor, we note that from Fig. 2 it follows that

$$cos = a \sin \beta,$$

and

$$\mathfrak{B} = a \cos \beta.$$

Now, from the equation slip $= \frac{c}{\mathfrak{B}} \times \frac{R}{k}$, we get $\frac{\text{slip}}{R} \times k = \frac{c}{\mathfrak{B}}$.

Therefore, by merely altering the scale of Fig. 2, we can re-name the sides of the triangle as shown in Fig. 4, where s stands for the slip.

From this we see that

$$\sin \beta = \frac{s}{\sqrt{R^2 + s^2}}, \text{ and } \cos \beta = \frac{R}{\sqrt{R^2 + s^2}}.$$

Therefore, the torque Q, which is proportional to $c \times \mathfrak{B}$, is proportional to $a^2 \sin \beta \cos \beta$; and, therefore, writing q as a constant depending on construction, we have

$$Q = q \cdot \frac{s\,R}{R^2 + s^2}.$$

And here we are also assuming that a, the impressed field, is constant; or that, in other words, the condition of supply is no longer that of constant voltage without magnetic leakage.

If we wish to see graphically what this equation means, we may plot out the relation between Q and s as a curve, assuming a definite value for R.

Take the line $O\ X$ (Fig. 5) to represent the speed of rotation of the magnetic field, and cut off from it a part, $O\ Q$, to represent the speed of the motor. Then the remainder, $Q\ X$, represents the slip. This is equivalent to plotting the slip backwards from X. The vertical ordinates then represent the values of the torque as calculated from the equation. For example, when $Q\ X$ is taken as s; $P\ Q$ is plotted to represent the corresponding value of Q. Thus we get a curve $X\ P\ t_1$, beginning at X when the slip is zero, which rises steeply, comes to a maximum, and dies away to the value $O\ t$, which is the torque at starting. The torque has a certain maximum value for which $\beta = 45°$. It will be noted that the steep end part of the curve is nearly straight, being anasymptote to a straight line, which would represent the relation between torque and slip if the magnetic field is constant and there were no magnetic leakage. In fact, this lines corresponds to the expression $T = b\ (\Omega - \omega)$ in the first paragraph of these notes. Or, if in our present equation we consider values of s which are small compared with R, the equation might be written $Q = q\ \frac{s}{R}$. At the other end of the curve where slip is great, the curve is hollow. Here we may approximate by supposing that s is very great compared with R, or that R^2 is small compared with s^2; in which case the equation reduces to $Q = q\ \frac{R}{s}$. This is the equation to a hyperbola (also shown in dot). When the motor is at rest $s = \Omega$, or $O\ Q =$ zero, giving at $O\ t_1$ the value $Q = q\ \frac{R}{\Omega}$. That is to say, *at starting* the torque is proportional to the resistance of the rotor. If we then assign a higher value to R, and plot out a new set of ordinates, we obtain a new curve (shown in dotted line) which also starts at X, rises to a maximum of the same height as before, and then falls, but this time to t_2. The effect then of introducing more resistance is to raise the torque at starting; but it also has the effect of causing the maximum torque to occur when the slip is greater. The motor gives out practically the same power as before, but runs with a greater difference of speed between its speed at light load and its speed at full load. And the efficiency at full load is diminished. If, with a 5 per cent. slip and a 95 per cent. efficiency, we do not get a sufficient starting torque, we can get it by introducing resistance, and contenting ourselves (at full load) with, say, a 10 per cent. slip, and a 90 per cent. efficiency. And one understands the reason for the modern device of constructing the rotor so that a resistance can be put in at starting, and then short-circuited as soon as the rotor has got up a fair speed.

Electrodynamic Machinery—XIX.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

97. One of the earliest types of operative dynamos was that in which the field consisted of a permanent magnet, and the armature was of the Siemens, or shuttle-wound, type. This armature consists essentially of a single coil of many turns of wire, wrapped in a deep longitudinal groove, formed on opposite sides of an iron cylinder. Owing to its simplicity, this early type of magneto-electric machine has survived in its competition with more advanced types, for such purposes as signal calls in telephony, and for firing electric fuses in mines. A machine of this type is shown in Fig. 80. The magnets $M\ M$, are usually compound; *i. e.*, consist of separate bars of hardened steel with their like poles associated as shown in the side view. The magnets are thus combined to form a single magnetic circuit through the armature, by means of soft iron pole-pieces N′ and S'. The armature core $A\ A'$, was originally formed of a single piece of soft iron, but is now always laminated, that is, formed of sheets of soft iron, laid side by side. The armature winding is in the form of a single coil or spool, and the ends of the coil are brought out to the insulated segments of the two-part commutator $C\ C'$, Figs. 81 to 84.

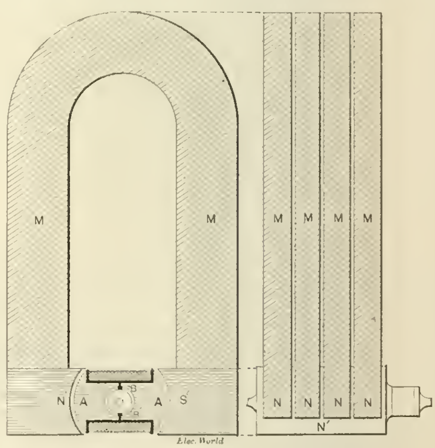
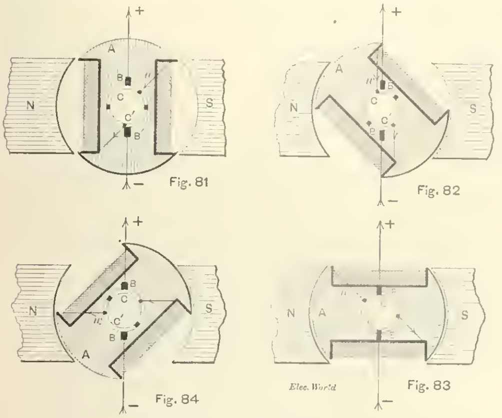


FIG. 80.—MAGNETO GENERATOR WITH SHUTTLE ARMATURE.

98. In order to determine the E. M. F. capable of being produced by a generator of this type and of given dimensions, it is

necessary first to ascertain the total quantity of flux which passes through the armature in the different positions it assumes during rotation. As shown in Fig. 81, the armature core lies at right angles to the polar line, and consequently no flux passes directly through its winding. When, during its motion, the armature reaches the position as shown in Fig. 82, where the end *A*, has approached the north pole, the flux is threading through the armature in a direction from the north pole *N*, to the south pole *S*. In Fig. 83, the armature core is shown as lying directly between the pole pieces. In this position the armature gives passage to the maximum amount of flux. In Fig. 84, the armature core is shown as moved beyond this position and is now reducing the



FIGS. 81, 82, 83 AND 84.

amount of flux threading through its core. Continuing rotation until the completion of a half turn, the position shown in Fig. 81, is reached, but now in the reverse direction; *i. e.*, with the end *A*, lowest instead of uppermost; and here the coil is emptied of flux as before.

99. It is evident, from a consideration of the preceding figures, that the amount of flux passing through the armature in any position depends upon the M. M. F. produced by the steel magnets; *i. e.*, upon their dimensions and shape, and on the reluctance of the air-gap, that is, on the dimensions and shape of the pole pieces, as well as on the *entrefer* or *air-gap* lying between the poles and armature.

For practical purposes a steel magnet may be regarded as producing a uniform difference of magnetic potential between its poles, except when the flux passing through the circuit represents an intensity greater than one kilogauss in the steel. We may prac-

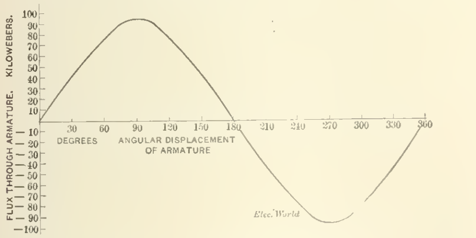


FIG. 85.—DIAGRAM OF FLUX PASSING THROUGH ARMATURE IN DIFFERENT ANGULAR POSITIONS.

tically consider that ordinary hard magnet steel maintains a permanent M. M. F. of 10 gilberts per centimetre of its length, independently of its cross section, and at the same time possesses a reluctivity of $\frac{1}{150}$. If then the magnets shown in Fig. 80, are 30 cms. long and have total cross section of 12 square centimetres, the M. M. F. they produce will be 300 gilberts and their reluctance $\frac{30}{12} \times \frac{1}{150} = \frac{1}{60}$ oersted. Neglecting leakage, the flux which will pass through the armature will, therefore, be $\frac{300}{\frac{1}{60} + \mathcal{R}}$ webers, where $\mathcal{R}$, is the reluctance of the two air-gaps in series. If, then, for different angular positions of the armature we plot the total length of air space in cms. (twice the length of the air-gap), and divide by the area of the armature beneath one pole in sq. cms., we obtain the reluctance $\mathcal{R}$, and, substituting in the above equation, we may determine approximately the magnetic flux through the armature for all positions during rotation.

100. Proceeding in this manner we obtain such a curve as is shown in Fig. 85, which represents the flux passing through the armature core at different position of angular displacement from the initial position shown in Fig. 81, and from actual measurements of a particular shuttle wound machine of this type. An inspection of this figure will show that at 30° displacement the flux through the armature will amount to about 40 kilowebers, while at 90° displacement, the position of maximum flux, it will reach about 93 kilowebers. From this position the flux decreases until at 180° its value is zero, the position assumed by the armature when it has completed one half ot a rotation and is again in the position represented in Fig. 81, but in the reverse direction. From this position onward, the direction of flux is reversed, the maximum flux being reached at an angular displacement of 270°, or ¾ of an entire rotation, completing a cycle at 360°.

(To be continued.)

Electrical Power Transmission—V.

BY LOUIS BELL, Ph. D.

Power Transmission by Continuous Currents.

28. The foregoing gives the rudiments of the machines used for generating direct current. It now remains, before taking up the question of power transmission proper, to consider briefly the use of such machines as motors. The underlying principle has been already discussed. The power of a motor to do work depends on the stress of the magnetic field on conductors carrying current in it and free to move. This stress is virtually the same as that which has to be overcome in using the machine as a generator, and reaches a very considerable amount in machines of any size.

In motors with the field strengths often used, the actual drag between field and armature wires may amount as a rough approximation to nearly an ounce pull on each foot of conductor in the field for every ampere flowing through the wire. With a twenty-horse power motor the actual twisting effort or *torque* at the surface of the armature might easily be considerably over a hundred pounds pull. Forces of this magnitude emphasize the need of solid armature construction, with the conductors firmly locked in place, particularly since the magnetic drag is not steady but comes violently upon the conductors as they enter the field. With the old smooth core armatures wound with wire, the conductors not infrequently worked loose and chafed each other, and even the entire winding has been known to slip on the core. In modern windings, either iron clad or modified smooth core, such accidents are nearly impossible.

When the armature conductors of the motor cut through its field as the armature revolves, an electromotive force is necessarily generated in them as in every other case when the magnetic forces on a conductor change. There is thus produced, as a necessary part of the action of every motor, a counter electromotive force in the armature. This electromotive force plays a very important part in the internal economy of the motor and is worth while looking at in detail.

In the first place the magnitude of the counter electromotive force determines the amount of current that can flow through the motor when supplied at a given voltage. The resistance of the armature measured from brush to brush may be only a few thousandths or even ten-thousandths of an ohm, while the applied voltage may be several hundred volts. The current, however, is not that which would flow through the given resistance under the pressure applied, but the flow is determined by the difference between the applied electromotive force and the counter E. M. F. of the motor, so that in starting a motor when the armature is at rest and there is therefore no counter E. M. F., a resistance is inserted outside the armature to cut down the initial rush of current.

In the second place, the counter electromotive force measures accurately the mechanical output of the motor for any given current. It does this because the very same things *i. e.* strength of field, amount of wire under induction and speed, which determine the output for a given current, also determine the magnitude of the counter electro-motive force.

Therefore, when the machine is running as a motor, while the energy supplied to it is the product of the voltage by the amperes which flow through the armature, the output of the motor is de-

termined by the product of the counter electromotive force into the self same current; hence, under given conditions, the ratio between the impressed and counter electro-motive forces of the motor determines the efficiency of the motor. The difference between these electromotive forces determines the input of energy, since it determines the current which may flow; therefore, as the counter electromotive force increases, the efficiency of the motor increases but the output is limited by lessening the input.

With a fixed electromotive force supplied to the armature, the output of the motor per ampere of current will diminish as the counter electromotive force diminishes, but the total amperes flowing will increase because the difference between the applied and counter E. M. F. has also increased. Thus, the total output increases, although at a lower efficiency, when the counter E. M. F. decreases. Since the input (which is determined by the difference between counter and applied E. M. F.'s,) multiplied by the efficiency (which is determined by the counter E. M. F.,) equals the net output of the motor, this output will be at a maximum when the counter E. M. F. and the effective E. M. F. are equal to each other. This follows from the general law, that the product of two quantities, the sum of which is fixed, will be a maximum when these quantities are equal.

29. In actual practice, motors are worked under very diverse conditions and some of these it is worth while to take up in detail following the preceding generalizations. The energy may be supplied at constant current, at constant voltage, with neither current nor voltage constant, at fixed or variable speed and subject to a wide variety of conditions; the motors may be wound either series or shunt, or with various modifications of these windings, and may be either self regulating as regards any of these quantities, or regulated by extraneous means. In the ordinary problems dealt with in power transmission, these conditions may be classified in a fairly simple way as follows:

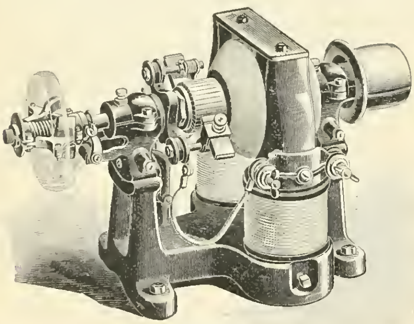


FIG. 18.

Case 1—Series wound motors at constant current.

Case 2—Series wound motors at constant voltage.

Case 3—Series wound motors with interdependent current and voltage.

Case 4—Shunt wound motors at constant voltage.

The first class is now comparatively little used, much less than formerly, and hence is not of great practical importance. The second class is very widely used in a particular case, to wit: electric railway practice, and consequently it is of great importance. The third class of motors is used occasionally with greater success but not very extensively, while the fourth includes the vast majority of all the machines running for purposes other than electric railway service. These cases, therefore, it is worth while to take up somewhat *in extenso*.

30. Case 1—Series wound motors operated with a constant current originally came into use in connection with arc lighting circuits, which for some years formed the most generally available source of current. Such lines are fed from dynamos in which the current is kept constant by special regulation while the voltage rises and falls, in accordance with the load, consisting of lamps or motors in series with each other. We are therefore relieved of any concern about the current, since it is kept constant quite irrespective of what happens in the motor.

Under these circumstances, in series wound motor the torque will be constant, since the field is constant, and the output of the motor will vary directly with the speed. If it be loaded beyond its capacity it simply refuses to start the load, inasmuch as its torque is limited by the current. If it starts with a load within its limit of torque its speed will steadily increase, until that limit is reached. This may be comparatively soon if the load is a rapidly increasing one, or the machine may race until its own friction of air and bearings, magnetic resistances and the induction of idle currents in the core or frame serve to furnish resistance up to its limit of torque. When running at a given speed any increase of load causes the speed to fall off, while decrease of load produces racing. Unless these tendencies are controlled, this type of machine becomes almost useless for practical purposes, as regularity of speed under change of load is generally highly desirable. In fact, the tendency to run at constant torque is generally inconvenient. To obviate this very serious difficulty various devices have been tried with tolerable success. The commonest is to vary the torque in accordance with the load by changing the field strength or by shifting the brushes so as to throw the armature coils out of their normal relation to the magnetic field.

Since the object of such changes is to vary the output at constant current and since this output is measured by the counter E. M. F. of the motor, the real problem of such regulation is to vary the counter E. M. F. in proportion to the output. Therefore the same means that serve to accomplish this end in an arc dynamo, keeping the current constant and varying the E. M. F., will serve to regulate the corresponding motor.

As in this case the speed is the thing to be held constant, the usual means taken for working the regulating devices is a centrifugal governor, which generally acts to shift the brushes or to put in circuit more or less of the field winding, which for this purpose is divided into sections. In still other arrangements the governor acts to slide the armature partially into or out of the field, or to work a rheostat which shunts the field magnet, as in the Brush regulator for constant current. An excellent example of a constant current motor regulated on the last mentioned principle is shown in Fig. 18.

As to the operation of these regulating devices, it is tolerably good if everything is carefully looked after, and kept in adjustment. The efficiency of such motors is not generally as high as that of other types, especially at light loads, owing to the nearly constant loss in the armature due to constant current working.

In addition, the circuit is highly dangerous, coming as it does from generators of very high voltage, and even the voltage across the brushes is, in machines of any size, sufficient to give a dangerous or even fatal shock. A ten-horse power motor, for example, on the customary 10-ampere circuit, would have a difference of potential of about 800 volts between the brushes at full load. As a few such motors would load even the largest arc dynamos, besides being dangerous in themselves, operations have generally been confined to smaller units. On account of the danger and the mechanical and other difficulties, the arc motor has come to be looked upon as a last resort, is seldom or never used when anything else is available, and, to the credit of the various manufacturers be it said, is nearly always sold and installed with a specific explanation of its general character and the precautions that must be taken with it.

In spite of all these objections the constant current motor often does good and steady work, and some such have been used for years without accident or serious trouble of any kind. They have been employed, however, only sparingly for power transmission work of any kind and appear to be steadily passing out of use.

(To be continued).

Practical Notes on Dynamo Calculation—XXI.

BY ALFRED E. WIENER.

40.—Actual Leakage Factor of Machine.

By a very simple method devised by the author [1], the total flux, Φ'' of magnetic circuit of a dynamo can be calculated from the running data of the completed machine, and the actual leakage factor for any particular dynamo can therefore be found for the formula

$$\lambda = \frac{z \times \Phi''}{\Phi} = \frac{\Phi'}{\Phi}, \qquad (135)$$

where Φ'' = Total flux of magnetic circuit, in webers, calculated from test-data ;

Φ' = Total flux in entire magnet-frame, in webers;

Φ = Useful flux cutting armature conductors, in webers, from formula (91) or (92), respectively;

z = Number of magnetic circuits in machine.

The writer, by employing his method above referred to, has

[1] Electr. Engineer, Vol. XVIII. p. 307 (Oct. 17, 1894).

figured the actual leakage-factors for nearly two hundred practical dynamos[2] of which the complete test-data were at his command, and by combining his results with the researches of Hopkinson[3], Lahmeyer[4], Corsepius[5], Esson[6], Wedding[7], Ives[8], Edser[9], and Puffer[10], has averaged the following Table LII., of leakage factors for dynamos of various types and sizes, which is to be used for obtaining an approximate value of the leakage co-efficient for the preliminary calculation referred to in Chapter 36.

From this table the general rule will be noted that the factor of leakage is the greater the smaller the dynamo, which is due to the difficulty or rather impossibility of properly diminishing the magnetic circuit in small machines. In these, on account of the comparatively large space occupied by the armature-winding, the length of the air-gaps is much larger, and the relative distances of the leakage surface much smaller, in proportion, than in large dynamos; the permeance of the air-gaps, therefore, is relatively much smaller, while the permeances of the leakage-paths are considerably larger, comparatively, than in large machines, and formula (110), in consequence, will produce a high value for the leakage co-efficient for a small dynamo.

It further follows from Table LII. that the leakage factor for various types and sizes of dynamos varies within the wide range of from 1·10 to 2·00, which result agrees with observations of Mavor[11], who, however, seems not to have considered capacities over 100 kilowatts. By comparing the values of λ for any one capacity the relative merits of the various types considered may be deduced.

Thus, it is learned that, as far as magnetic leakage is concerned, the horizontal double magnet type (column 6) and the bipolar iron clad type (column 7) are superior to any of the other types, which undoubtedly is due to the common feature of these types of having the cores of opposite magnetic potential in line with each other on opposite sides of the armature, thus reducing the magnetic leakage between them to a minimum.

Next in line, considering bipolar dynamos, are the inverted horseshoe type (column 2), the single magnet type (column 4), the upright horseshoe type (column 1,) and the vertical double horseshoe type (column 8).

Of multipolar machines the two best forms, magnetically, are, respectively, the inner-polar type (column 13) and the radial multipolar type (column 12.) In the first named of these types the magnetic-cores form a star, having a common yoke in the center, and the polar-pieces at the periphry; thus the distances of the leakage paths increase in direct proportion to the difference of magnetic potential, a feature which is most desirable and which accounts for the low values of λ for the type in question.

The most leaky of all types seem to be the horizontal single horseshoe type (column 3) and the axial multipolar type (column 15). In the former type the excessive leakage is due to the fact that the magnetic circuit is suspended over an iron surface extending over its entire length, while in the latter type it is due to the comparatively close relative proximity of a great number of magnet-cores (two for each pole) parallel to each other.

(To be continued.)

CAPACITY IN KILO WATTS	FACTOR OF MAGNETIC LEAKAGE.															CAPACITY IN KILO WATTS
	1 UPRIGHT HORSESHOE TYPE	2 INVERTED HORSESHOE TYPE	3 HORIZONTAL HORSESHOE TYPE	4 SINGLE MAGNET TYPE	5 VERTICAL DOUBLE MAGNET TYPE	6 HORIZONTAL DOUBLE MAGNET TYPE	7 BIPOLAR IRON CLAD TYPE	8 VERTICAL DOUBLE HORSESHOE TYPE	8 HORIZONTAL DOUBLE HORSESHOE TYPE	10 FOURPOLAR IRON CLAD TYPE	11 SINGLE MAGNET MULTIPOLAR TYPE	12 RADIAL MULTIPOLAR TYPE	13 INNER-POLE TYPE	14 TANGENTIAL MULTIPOLAR TYPE	15 AXIAL MULTIPOLAR TYPE	
1	2·00	1·75	....	1·90	....	1 50	1·60	....	....	....	....	....	....	....	....	·1
·25	1·80	1·60	....	1·75	2·00	1·40	1·40	....	....	....	....	....	....	....	....	·25
·5	1·70	1 50	2·00	1·65	1·90	1·35	1·35	1·80	1·90	....	....	....	....	....	....	·5
1	1·65	1·45	1·90	1·60	1·80	1·30	1·30	1·70	1·75	....	....	....	....	....	....	1
2·5	1·60	1·40	1 80	1.55	1.70	1·28	1·28	1.60	1·65	1 75	1·60	1.50	1·40	1·90	2·00	2.5
.5	1·55	1·35	1·75	1·50	1 65	1·25	1·25	1·55	1·60	1·65	1·50	1·40	1·35	1·80	1 90	5
7·5	1 50	1·30	1·70	1·45	1 60	1 22	1·22	1·50	1·55	1·60	1·45	1·35	1·32	1·70	1·80	7.5
10	1·45	1·28	1·65	1·40	1·55	1·20	1·20	1·45	1·50	1·55	1·40	1·32	1·30	1·65	1·70	10
.25	1·40	1·25	1·60	1·35	1·50	1·18	1·18	1·40	1·45	1·50	1·35	1 30	1·28	1 60	1·65	25
50	1·35	1·22	1·65	1·32	1·45	1·15	1·15	1 35	1 40	1·45	1 80	1·28	1·25	1·55	1·60	50
100	1·30	1·20	1·50	1·30	1·40	1·12	1.12	1·80	1·35	1·40	1·25	1·25	1·22	1·50	1 55	100
200	1 25	....	....	....	....	....	....	....	....	1·34	1·22	1·22	1·20	1·45	1.50	200
300	1 20	....	....	....	....	....	....	....	....	1·35	1·20	1·20	1·18	1·40	1·45	300
500	....	....	....	....	....	....	....	....	....	....	....	1 18	1·15	1·35	1·40	500
1000	....	....	....	....	....	....	....	....	....	....	....	1·16	1·12	1·30	1·35	1000
2000	....	....	....	....	....	....	....	....	....	....	....	1·15	1·10	1·25	1·30	2000

TABLE LII.—LEAKAGE FACTORS FOR VARIOUS TYPES AND SIZES OF DYNAMOS.

[2]For list of machines see Introduction, Electr. World, Vol. XXIII, p. 675 (May 19, 1894).
[3]J. & E. Hopkinson Phil. Trans. 1886. Vol. I.
[4]Wm. Lahmeyer, Elektrotechn. Zeitschr., Vol. IX. p. 89 & 283 (1888).
[5]Corsepius, Elektrotechn. Zeitschr. Vol. IX. p. 235 (1888).
[6]W. B. Esson, The Electrician, (London), Vol. XXIV, p. 424 (1890); Journal Inst. Elec. Eng., Vol. XIX, p. 122 (1890).
[7]W. Wedding, Elektrotechn. Zeitschr. Vol. XIII, p. 67 (1892).
[8]Arthur Stanley Ives, Electr. World, Vol. XIX, p. 11 (Jan. 2, 1892).
[9]Edwin Edser and Herbert Stansfield, Electr. World, Vol. XX, p. 180 (Sept. 17, 1892).
[10]Puffer, Electr. Review (London). Vol. XXX, p. 487 (1892).
[11]Mavor, Electr. Engineer (London), April 13, 1894; Electr. World, Vol. XXIII, p. 615 (May 5, 1894).

Over Compounded Dynamos in Parallel.

BY A. F. HEMINGWAY.

I noticed in a recent issue of The Electrical World an article on the working of compound wound dynamos in parallel by Prof. E. P. Roberts, in which one trouble put forward was the lack of proper regulation when not all of the dynamos are in circuit.

It is evident that if a pair of such dynamos of equal capacities are working in parallel and over-compounded 10 per cent. with 10 per cent. loss in the feeders, and the load drops to a point (say one-half) where one dynamo is sufficient to handle it, the P. D. at the terminals with the single dynamo remains 10 per cent., while the loss in the feeders is decreased to 5 per cent.; there thus results an increase of voltage of 5 per cent. at the lamps, thereby decreasing their life efficiency.

The writer has in mind a method that may be added to those given by the author of the article mentioned, taking the case as cited above and shown in the accompanying sketch. The method consists in cutting out the required number of turns in the series coil, in this case about one-half, which results in only five per cent. rise in voltage in place of ten, and this without any additional manipulation of switches when the change is being made. Referring to the sketch A, B, C, A_1, B_1, C_1, are the main switches, and D, D_1, jaws with the terminals of the short series coil and main connected. Assuming that the dynamos are running and giving their proper current and the load drops where it may be thrown upon one dynamo, by opening the switches A. B. C., the blade marked C engages with the jaws D, which closes the circuit containing the short series coil

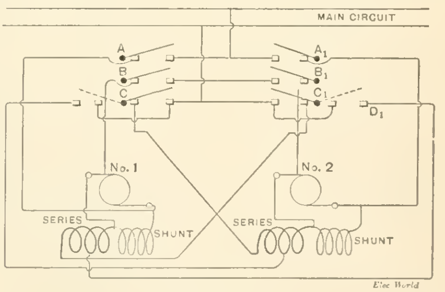


DIAGRAM OF CIRCUITS.

of the dynamo in operation, thus giving the required potential at its terminals. It will be seen that the arrangement will in no way affect the regulation when both are running in the usual way and that two or more dynamos of equal or unequal capacity may be arranged to give the same results,

The Chloride Accumulator.

The Electric Storage Battery Company announces officially that it has acquired all the patents and patent rights concerning the manufacture of electric storage batteries of the General Electric Company, the Edison Electric Light Company, the Thomson-Houston Electric Company, the Brush Electric Company, the Accumulator Company, the Consolidated Electric Storage Company and the General Electric Launch Company, whereby the Electric Storage Battery Company has secured to itself the sole right to supply in the United States electric storage batteries of all the various important types heretofore developed, as well as the protection of every decision heretofore rendered by the United States courts in the interpretation of electric storage battery patents. The acquisition of these patents, the company states, not only terminates all litigation heretofore existing, but insures against any future attacks, as the patents acquired together with those originally owned by the Electric Storage Battery Company cover all the known principles involved in storage batteries. It announces that it has also increased largely its cash working capital, and is now fully prepared to fill all orders for storage batteries.

The Foundations of Mathematical Analysis.

To the Editor of The Electrical World:

Sir:—In a recent article on Electromagnetic Theory (London *Electrician* Nov. 23) which formed the occasion of the editorial reproduced in your columns (THE ELECTRICAL WORLD, Dec. 8.) Mr. Heaviside favors us with his view of the foundation of mathematics. He says that mathematics is fundamentally an experimental science; and that the science of nature might be studied as a whole, the properties of space along with the properties of the matter found moving about therein; and that it would be to the advantage of a student of physics to pick up his mathematics along with his physics. From this and other statements in the article I gather that in his view the properties of space constitute the foundation of mathematics, while the properties of matter constitute the foundation of physics. He shows explicitly how geometry has an experimental, (or rather experiential) foundation; but to make good the general statement it is necessary to show that algebra also has an experiential foundation.

At the present time it is customary for writers on algebra to place that science on a purely formal basis. The rules which are to be followed in the manipulation of symbols are enunciated as formal laws—called the laws of commutation, association, and distribution—and very little attention is given to the meaning of these laws as truths of nature. They were found to be true of integer numbers, and they are supposed to be true for any extended meaning of the symbols. The consequence is that the development of algebra is arrested at angles in a plane, the further step to angles in space is not being taken because these supposed necessary laws cease to apply. The extent to which these fundamental laws are true in space analysis, and the points where they break down or require to be modified, were shown at length in a paper which I read before the American Mathematical Society at their Brooklyn meeting. From that and other investigations I am led to the view that the properties of space are the foundation of pure mathematical analysis, while those of space, time and mass constitute the foundation of what is called applied mathematics. These two parts of analysis merge into one another; they are equally pure, equally exact, and they equally apply to that of which they are the analysis. The difference lies not in purity, exactness or applicability, but in the fundamental ideas or subject of analysis.

Mathematicians who maintain the formal view of algebra encounter a difficulty in the obviously geometrical nature of the cosine, sine and other circular functions. The hyperbolic functions also have a geometrical meaning; while the exponential function has an intimate relation with both. But remove the circular, the hyperbolic and the exponential functions from the higher analysis, and how much will then remain? The formal view has led some analysts to the extreme step of defining the sine and cosine as the sums of certain infinite series. But in reply, it may be pointed out that the equality of the sine to the sum of a certain series is not a definition, but a truth, and a very striking truth to anyone who makes the calculation for a large angle.

I am convinced that progress in mathematical analysis will be accelerated by taking an intensely geometrical, even a physical, view of the foundations.

Ithaca, N. Y. ALEXANDER MACFARLANE.

The National School of Electricity.

To the Editor of The Electrical World:

Sir:—Permit me to commend your very judicious editorial in THE ELECTRICAL WORLD of Deceember 8, on the National School of Electricity. It is very evident that a widespread desire exists to learn more about electricity. In fact it was this demand that led to the organization of the National School. It has been very successful in forming classes; and though a mistake has occasionally been made in obtaining local instructors, yet the majority of them by far have been capable young men.

Those whom I have recommended for classes in this vicinity have been appointed, and I know them to be capable and honorable.

But the time has now come for the organization to take the public more into its confidence. The "Honorary Faculty" were expected to aid the movement by honorable means only and to prepare the lessons; in some cases also to deliver addresses or lectures before such classes as they could reach without too much inconvenience. The lessons have been prepared thus far by one member of the "Honorary Faculty" who very properly receives a reasonable compensation for his services. I have myself read the proof I think of all the lessons and have made some suggestions, and, it may be proper to add, without compensation. Another member, who is best fitted for the work, will have charge of the preparation of another course of lessons in a special line. The lessons are thus actually prepared by members of the "Honorary Faculty." To the management the school is doubtless a business venture, with the expectation and evident desire to give to the young men who enter the classes full value for their money. But while the plan is an honorable one, its inception is beset with difficulties and it is certainly capable of improvement. The changes which are required to insure success, I understand, are about to be made.

Ann Arbor, Mich. HENRY S. CARHART.

Efficiency of Street Railway Generating Plants.

To the Editor of The Electrical World:

Sir:—In your issue of Dec. 1st appears an editorial criticism of the article by Mr. G. H. Davis on "Economy Tests of Electrical Railway Plants" printed in the same issue, and I quite agree with you as to the reported efficiencies being unattainable in ordinary railway work. As far as station efficiency alone is concerned, there seems to me one way every station manager can keep a fairly accurate eye on results, daily or weekly, and that is by having recording watt-meters to register the output. From this the actual amount of coal per horse-power hour is readily determined. If there are any stations approximating the result given by Mr. Davis, day in and day out, I am quite sure all station managers would be glad to learn how the results are attained, and in any event all station managers would be glad to know just what others are doing.

Reports embodying *exact measured results* in actual running, month in and month out, and including the cost of coal per ton of 2,000 pounds, the kind of coal used, and the horse-power per hour or day, would be of the greatest of value. In talking with a large number of managers in the last few months I have been struck with the fact of how few really know what their output is, beyond the maximum or minimum readings and a guess at the average. A. C. BALCH.

Portland, Ore.

Transformer Testing.

In the article on "Transformer Testing," in our issue of December 8, line twenty-nine, on page 593, should read, "when secondary circuit is open" instead of "when secondary current is open;" also, beginning line forty-two, next column, read, "The core loss, which is constant at all loads, may be got by multiplying the apparent power absorbed at no load by 0.8," instead of by "OS" as printed.

State Telegraphy Silver Wedding.

A proposal is under consideration in England to celebrate in some becoming way the Silver Wedding of the State and the Electric Telegraph. That union was effected on Feburary 5, 1870, and the parties will, therefore, have reached the twenty-fifth year of a prosperous and profitable wedded life on February 5th next year.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS
BY CARL HERING

ELECTRO-PHYSICS.

Vaporization of Carbon.—An academy paper, by Mr. Moissan, is published in "L'Elec.," Nov. 24, and abstracted in "L'Eclairage Elec.," Nov. 17. He describes some new researches with his electric furnace; the current used was about 1,000 to 1,200 amperes and 80 to 90 volts; a rod of pure carbon was vaporized, and formed a sort of felting in depositing; heated in a vacuum it was transformed in ten minutes into graphite; his object was to find whether carbon passed through a liquid state before being vaporized, and from his results he concludes definitely that carbon, if pure, did not liquify; with impure carbon, however, the results were different. He obtained similar results with carbon for sugar and with charcoal; when gaseous carbon solidifies it always changes into graphite; this is also shown in an incandescent lamp, in which, he says, the deposit on the globe will be found to be graphite. He believes, however, that carbon can be made to liquify, but only under pressure; and in that case, as he has shown, the density of the carbon increases, forming diamonds. In solidifying under these circumstances it may form as crystals, as globules, or in an amorphous state.

Cathode Rays.—A paper by Mr. Brooks is begun in the Lond. "Elec. Rev.," Nov. 30. He discusses the views recently published in that journal (see Digest Nov. 24), in which it was stated that the results recently obtained by Dr. Leonard were not in accordance with Crooke's theory or with the kinetic theory of gases. He does not believe that these views will be generally accepted, and he examines the facts upon which these conclusions are based.

Nature of Cathode Rays.—"L'Eclairage Elec.," Nov. 17, contains an article by Mr. Blondin in which he gives a resume and a discussion of the subject, concluding that the hypothesis of Lenard, is a very probable one, but as the nature of these rays is still uncertain, one should wait for further experimental results before accepting this hypothesis.

Reflection and Resonance.—An article by Mr. Birkeland, from the "Weid. Ann.," Vol. 52, page 486, is abstracted in "L'Eclairage Elec.," Nov. 17.

The Work of Hertz and the Results.—An article by Prof. H. Ebert on this subject is contained in the "Rev. Gen. des Sciences," Oct. 30.

Origin of Frictional Electricity.—A paper by Mr. Christiansen from the "Weid. Ann.," Vol. 53, page 401, is abstracted in the "Elec. Zeit.," Nov. 29. He describes experiments which he claims prove that friction by itself produces no electricity, but that the action which is usually attributed to friction arises from chemical decomposition, produced by the contact and the subsequent separation.

Energy of the Amperian Molecule.—In the "Phil. Mag." for December, Mr. Chattock publishes a note supplemental to his paper, abstracted in the Digest Nov. 24.

Conductivity and Pressure.—A paper by Mr. Tammann, from the "Zeit. fuer. Phys Chem.," Vol. 14, page 433, on the alteration of conductivity in liquids by pressure is recommended and briefly abstracted in the Lond. "Elec. Rev.," Nov. 30. It is of a theoretical nature, and it is believed that the line of investigation may turn out to be very fruitful.

Electricity.—The seventh paper by Mr. Walker, on "What Is Electricity?" is published in the Lond. "Elec. Eng.," Nov. 30. He discusses the reflection of electrical waves. He believes that the nature of electricity is simply a mode of motion just as heat, light and sound, but at a different rate, and possibly in a different manner. He showed if it could be shown that electrical waves are reflected and refracted it would be a strong argument in his favor. Hertz went a long way toward proving this.

Demonstrating the Existence of Thermo-Electric Currents.—A lecture apparatus exhibited at the French Physical Society by Mr. Guillaume is described briefly in "L'Ind. Elec.," Nov. 25. A wheel about 6 inches in diameter has its felloe made of a fine wire of an alloy of nickel and copper, and its spokes of fine copper wires, the wheel turning on pivots; a horse-shoe magnet placed so as to "embrace a semi-diameter of the wheel. If the other extremity of this diameter is heated the wheel will revolve.

Thermo-Elements of Metals and Solutions.—A paper, by Mr. Hagenbach, from the "Weid. Ann.," Vol. 53, page 447, is abstracted in the "Elec. Zeit.," Nov. 29.

MAGNETISM.

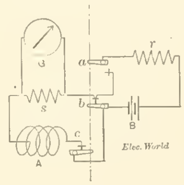
Critical Point in Nickel.—A paper, by Mr. Heydweiller, from the "Weid. Ann.," No. 7, p. 462, is abstracted with curves and tables in the Lond. "Elec.," Nov. 30. Villari observed that with iron under tension the increase in permeability reached a maximum, then fell to its original value and then below this. The point at which it attains the same value that it had with no tension, is known as Villari's critical point. Up to now no such point has been observed in nickel. The present experiments were undertaken with the intention of settling the point, whether the difference between iron and nickel was qualitative and not merely due to the fact that the values used heretofore were not sufficiently low.

Mirrors of Magnetism.—A Physical Society paper, by Prof. S. P. Thompson and Mr. Walker, describing some experiments, is briefly abstracted in the English journals of Nov. 30.

Intense Magnetic Fields.—A good illustration, with all the accessories, of the intense magnet of du Bois, mentioned a number of times in these columns, is published in "La Nature," Nov. 24.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A Simple Method for Determining Inductance-Coefficients.—In the "Elec. Zeit.," Nov. 29, Dr. Hiecke describes a method which he published in June, 1887, in the reports of the Vienna Academy. It requires no condensers, nor any compensation in a bridge method the former of which is generally a source of inaccuracy. The arrangement is shown in the accompanying diagram, in which A is the coil to be measured;



METHOD OF DETERMINING INDUCTANCE COEFFICIENTS.

G, s is a galvanometer with its shunt; r is an inductionless resistance, and a, b, c, are three switches which are operated by a weight which descends with its own acceleration along a vertically stretched wire, falling about 1.5 meters before striking the switch a. The exact time of closing the first switch is not so very important, but that between striking the 2d and 3d switches can be determined very accurately. The 2d contact b, can be adjusted with a micrometer screw. A second test is made with an inductionless resistance R in place of A. The resistance of the cells, if small, need not be considered, or can be included with r. The inductance coefficient and the resistance of the galvanometer do not enter into the final formula if

$$\frac{s^2}{(G+s)\,(R+r+s)}$$

and the corresponding expression for R^1 in place of R are negligibly small in comparison with unity (R being the resistance of the coil A). This can easily be reached with the Thomson mirror-galvanometer. Owing to the fact that the resistance of the switch a was relatively great, a small current circulated when it was closed. Let the deflection due to both this and the succeeding current together be ϕ, then replace A with R' and let the deflection be ϕ. To correct these for the first current impulse it was determined separately by lowering the switch b so that c was opened before b. Let the deflections for A and R be ϕ and ϕ' both of which are always very small; then an approximate value of the self-inductance coefficient will be given by the formula

$$S^1 = t\,r_1\left(1 - \frac{\varphi - \psi}{\varphi^1 - \psi^1}\,\frac{r_1}{r_1^1}\right)$$

in which $r_1 = R + r + S$ and $r_1^1 = R^1 + r + S$; t is the time (presumably in seconds) between the opening of switches b and c. This is under the assumption that the time t is sufficiently great to cover the period during which the induction phenomenon acts. If not quite sufficient the difference between this and the true value is very slight, and can be calculated from the following formula (it is not stated whether the result is in henries or absolute units).

$$S = S^1\left(1 + e^{-\frac{r_1}{S^1}t}\right)$$

An example is worked out. He gives three methods by which the time t may be determined.

Telephonic Measurements of E. M. F.—In a paper on this subject, by Mr. Barus, of Washington, D. C., published in the "Phil. Mag." for December, he discusses the use of the telephone in place of the galvanometer in zero methods. He found great difficulty in making the telephone sensitive enough, and shows that the range on both sides of zero within which the telephone does respond, is out of proportion with the sensi-

tiveness of the instrument. The object of the present paper is to find the extent and character of this silent interval, and its relation to the method in question. He quotes the literature on the subject, and describes the apparatus and the method which he used, including a table of results. He concludes that in the measurement of the E. M. F. the telephone does not come up to the requirements. It is possible to define an E. M. F. of about one volt with an accuracy of about one in 1,000. For pyrometry the telephone can be used only in rough work.

Determining Conductivities.—The Lond. "Elec. Rev.," Nov. 30, calls attention to a paper by Mr. Wildermann from the "Zeit. fuer Phys. Chem.," Vol. 14, page 247, in which he describes a new method which has important advantages over the Kohlrausch method, which appears to be unsuitable for slightly dissociated compounds, and almost useless for organic bases or acids in alcohol or other organic solutions. The chief difference lies in the use of a far stronger E. M. F., by which the polarization becomes practically negligible, and a galvanometer can be used instead of a telephone. The measurement of conductivity resolves itself into the measurement of the current. He uses about 150 volts, and places the liquids in capillary tubes. The method is said to have considerable value.

Localization of Faults in High Tension Net Works.—In the Lond. "Elec.," Nov. 30, Mr. Raphael gives a summary, with illustrations, of the methods which may be used first while running, and second when disconnected. The methods themselves do not appear to be new, although some of the details may be useful. The method of testing from the station with the aid of pressure wires appears to be the well-known bridge method in which the wire is connected to the two station ends of the two feeders between the other ends of which the fault lies. Another method described is the ordinary fall of potential method. Regarding the telephone method in which the operator walks along the street with a triangular shaped coil held parallel to the cable, he states that it cannot be relied upon to locate the fault and is often misleading.

Measuring the Capacity of a Condenser.—A physical Society paper, by Mr. Womack, on a modification of the ballistic galvanometer method of determining the electromagnetic capacity of a condenser is briefly described in the English journals of Nov. 30.

Electrometer.—A new form designed by Prof. Ayrton and Mr. Mather, is described in a Physical Society paper abstracted in the English journals of Nov.30. The fixed and moving parts (inductors and needle) are alike cylindrical in form (the term being understood in its most unrestricted sense) and the generating lines are vertical. There is a vertical axis of symmetry, such that the disposition of these cylindrical parts would remain unchanged if the instrument were rotated thorugh 180 degrees about the axis. The needle is hung by a very thin phosphor-bronze strip, and to obtain a reading when it differs in potential from the inductors by an amount which has to be measured, it is brought back to its ordinary zero position by turning a torsion head to which the upper end of the suspending strip is fixed. The potential difference is then proportional to the square root of the angle through which the torsion-head has been turned; but the E. M. F. of a moderate battery of accumulators can be read with very fair accuracy The authors have bestowed great care on the design of the needle, so that for a given potential difference the turning moment divided by the moment of inertia may be as great as possible. The whole instrument is protected from external inductive influence by having the inner surface of its glass case coated with a transparent conducting varnish, which Prof. Ayrton has described elsewhere. He also showed an idiostatic electrometer, in which the needle was pivoted on an axle. The instrument is nearly dead-beat, and gives about three inches for 100 volts.

Sensitive Form of Thomson Galvanometer.—In the "Phil. Mag." for December, Mr. Wadsworth, of Washington, D. C., describes a sensitive form devised by himself, the description being accompanied by good illustrations. The description does not admit of being abstracted, and those specially interested should read the original. The coils have a peculiar shape, the object of which is to obtain the most economical disposition of the wire with, apparently, as low a resistance as possible. The total number of turns is almost 10,000, and the resistance is 86 ohms. The constant, with a magnet system, which he says could be improved considerably, was 4×10^{-11}, inches, which represents the current in amperes required to produce a deflection of 1mm. at a distance of one meter, for a time of single swing of 10 seconds. He discusses at some length the question of the influence of the mass of the magnetic system on the delicacy.

Amyl-Acetate Lamp.—According to a report of the German Reichsanstalt, the moisture in the atmosphere effects the candle-power of the Hefner lamp to the extent of several per cent. This is important only for very accurate measurements, and need not be considered in ordinary measurements in which the accuracy of the measurements depends more on the ampere and voltmeters, as the candle-power of incandescent lamps varies "eight times as rapidly as the energy."

Specific Inductive Capacities of Water, Alcohol, Etc.—In a short article by Mr. Fessenden, in the "Phil. Mag." for December, he points out that the values obtained by various experiments are not correct, but that the true values in all of these substances are very nearly equal, and what is called for by Maxwell's theory, that is, to the square of the refractive index. The reason for the errors lies in the fact that electrolysis gives a capacity effect. Kohlrausch's method always gives erroneous results, as it measures the impedance and not the resistance. All capacity measurements made by a discharge are also incorrect. The only correct method consists in purifying the fluid until it no longer conducts appreciably, and also by using a powerful source of current. He states that all the determinations for sulphur, etc., are also incorrect.

Physical Units.—The serial by Mr. MacLean is continued in the Lond. "Elec. Eng.," Nov. 30. He discusses the electro magnetic system.

ARC AND INCANDESCENT LIGHTS.

Continuous and Alternating Current Arcs.—The discussion of Dr. Fleming's paper (see Digest, Nov. 17 and Dec. 8), is concluded in Lond. "Lightning," Nov. 29. Mr. Ferranti stated that although he had done his best in favor of alternating current arc lighting, he now admits the superiority of the continuous current lamps, quite apart from the question of efficiency. The alternating arc gives an unpleasant violet light, which he thinks is a most objectionable feature. He mentioned that Dr. Fleming's comparison had nothing to do with the mechanism of the lamp, and he believes that no improvement can better the state of affairs which was found. The vital point of difference in efficiency lies in the fact that in one case, almost the whole energy is used to incandesce one crater, whereas in the other the same amount of energy must be distributed over two surfaces, and consequently the economy of the one can never reach that of the other. The difference between the true watts and the apparent watts is only about 5 per cent. In order to produce the same mean spherical candle-power in the alternating current arc, it is necessary to expend about 50 per cent. more power. But this assumes a perfect reflector near the arc, which is an impossible assumption, and therefore to get about as good a practical effect, nearly twice the energy will be required. Mr. Kolle reduced the diagrams to the same scale, which is published, and shows that it then clearly points out the advantages of a direct current lamp for street lighting. Alternating arcs have their special sphere in the lighting of low interiors. He favors the use of rectifiers. Dr. Fleming, in closing the discussion, replied principally to the remarks of Mr. Preece, which he thinks show that his paper was not read with sufficient care, and in which he claims to have been misquoted. He refers to the recent researches of Messrs. Roessler & Wedding (see Digest, July 7, Aug. 4, Sept. 22), who came to the same conclusion after an elaborate series of experiments. He claims that to use one and the same form of lamp in his tests was the only proper thing to do. He is at present repeating the tests. He admits, that aside from the question of the relative energy consumption there remains the question of practical convenience, to which great weight must be given. Regarding the point brought out by Mr. Wright, namely, that with an equal amount of energy, both should give an equal amount of light. He explains that the usefulness of any radiation for the purpose of vision depends on the wave lengths of that radiation. An arc which converts energy mostly into red, yellow and green rays is the most efficient for purposes of vision.

Aluminium Leading in Wires.—A system devised by Mr. Bolton is described and illustrated in the Lond. "Elec.," Nov. 30. The two wires are fused in a rod of glass which cracks when it cools owing to the difference of expansion; the glass is then fused into the end of the lamp and the joint between the glass and the wire made tight by applying a drop of a strong solution of mercuric chloride, to the outer ends of the wires during the exhaustion of the lamp; this substance oxidizes the aluminium, which oxide is said to make an air-tight joint; should a small leak occur it will cure itself by the action of the oxygen on the remaining aluminium amalgam, precisely at the point where it is needed.

Holophane Globes.—Some good illustrations of the holophane globes described in the Digest, Nov. 10, are published in "La Nature," Nov. 24.

Interior Illumination.—An abstract in French of the article by Mr. Nerz (see Digest, Sept. 22) is published in "L'Eclairage Elec.," Nov. 17.

ELECTRIC RAILWAYS.

Traction.—The article by Mr. Pellissier, mentioned in the Digest, Dec. 8, is concluded in "L' Ind. Elec.," Nov. 25. He discusses the total force of traction, the practicable application of the tables which he gives and the subject of adherence.

Propulsion of Boats.—The system described in the Digest, Nov. 3 and 17, is the subject of an illustrated article by Mr. Guilbert in "L'Eclairage Elec.," Nov. 17; the illustration includes good working drawings, to scale. The results and tests were very satisfactory; with the velocity obtained, 2.4 miles per hour, and the time gained in passing locks, it is easy with the new method to double the total velocity and to obtain a mean speed of 18 to 21 miles per day.

Electric Carriages.—An article by Mr. Reyval is begun in "L'Eclairage Elec.," Nov. 17. He believes that carriages run with petroleum or steam are too expensive and that the ideal power is electrical energy. He gives a summary of the history of electrically operated carriages.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Small Gas-Engine Accumulator Stations.—The "Elek. Anz.," Nov. 29, gives the details of an estimate apparently made by a German firm, of the cost of a small station; the figures are approximately as follows in dollars: Building, $2,420; engine and dynamo for 115 volts and about

165 amperes, complete, $7,500; accumulators, 62 cells of 572 ampere-hours, $4,000; total, including switchboard accessories, crane and tools, $15,000; for the running cost it is assumed that there will be 750 lamps and that they will be used on an average 900 hours per year; also that 40 per cent. of the total energy is supplied by the accumulators, on which account 15 per cent. is added to the gas consumption; this gives a total gas consumption per year of 1,500,000 cu. ft.; for oil he allows $123 per year, for waste $75, for the maintenance of the accumulators 5 per cent. of their cost, sulphuric acid $50, for attendance $750 for two men, and $125 for general office expenses; at two different prices for gas he finds that the interest earned on the capital will be 17.1 per cent. or 12.9 per cent.

Day-load.—An editorial in the "Elec. Zeit.," Nov. 29, summarizes briefly the methods used in three English central stations for reducing the relative cost of the output during the day; at Bristol the current during the day is generated by a gas-engine running about eight hours in winter and relatively longer in summer, thus reducing the attendance during that time to about one-third; in Worcester the dynamos are run during the day by water power alone, which, though not sufficient for the night-load, is ample for the day-load; at Ealing, the town refuse is used as part of the fuel and during the day the refuse alone is sufficient.

Electrical Industry in France.—Some of the comparative data from a recent paper from the "L'Ind. Elec." (see Digest, Nov. 17), giving some figures concerning a few of the largest stations in Europe, are published in the Lond. "Elec. Rev.," Nov. 30.

Installations in Switzerland.—Some interesting statistics for the year 1893 are given in "L'Ind. Elec.," Nov. 25; the increase in the number of installations in 1893 was about 21 per cent.; at the end of the year about 52 per cent. of the generators were driven by hydraulic power.

Altona.—A large amount of data concerning the operation of this station for one year, is published in the "Elec. Zeit.," Nov. 29.

Bedford.—A long and well-illustrated description of this station is published in the Lond. "Elec. Eng.," Nov. 30; the high pressure alternating system is used with sub-stations and the three-wire method.

Elastic Couplings for Gas Engines.—A theoretical discussion by Mr. Guillaume is published in 'L'Ind. Elec.," Nov. 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Cable Signalling.—Some recent experiments with data regarding the speed, are given by Mr. Delany in the Lond. "Elec.," Nov. 30. They were made on several of the Atlantic cables with a specially designed system of automatic transmission; a mean of 274 messages on a certain day showed a speed of 88 letters per minute, and on another occasion 95.5 letters per minute; on another occasion 111 letters per minute were transmitted and repeated back without any error. An experiment was made with a repeating system arranged by him, which, from the results obtained, he believes will lead to important changes in cable working; he claims that they show beyond any doubt that transmissions may be effected from long land lines into ocean cables at the same speed as cables are worked. He also mentions a system with which he has been working, for using the key and sounder for long cables; recently with the 1894 cable he transmitted 66 letters per minute with an ordinary Morse sounder, which were automatically repeated to London and were pronounced good signals; with a special transmitter he thinks that a speed of 100 letters per minute could have been reached; he believes that in the near future all long cables will be operated by the automatic machine system. In an editorial discussion, belief is expressed that the annual cost of long land line is by no means insignificant and that it certainly would be cheaper for a company owning more than one cable, to work a single land line with a high-speed Wheatstone rather than to provide a land line for each cable; the editorial concurs in the opinion that long cables will be worked by the automatic system.

Pacific Cable.—The "Jour. Telegraphique," Nov. 25, publishes a very good map of the Pacific ocean with the five different proposed cables starting at Victoria, and discusses them; it prophesies that the realization of this crowning work is but a few months distant; the article considers the accusations of Siemens of great value, but those of Sandford Fleming as a little optimistic and leaving some doubts. In conclusion it states that a Pacific cable from New Caledonia through the Sandwich Islands should connect with the nearest shore of the United States, as, for instance, at San Diego in California, this being unquestionably the shortest and cheapest route; the dangers of such a cable against the security of the British possessions it believes are purely imaginary; such a project "should have a cosmopolitan character and it should fulfill in the most effective manner one of the most noble ends of telegraphy, that is, to tighten the bonds of the great human fraternity."

Berlin-Vienna Telephone Line.—According to the English journals of Nov. 30, this line, which is about 500 miles long, has just been completed and the first tests were very successful; it is believed that it will soon result in a second and even a third line being constructed.

Time Distribution in the United States.—An illustrated descriptive article by Mr. Pellissier is begun in "L'Eclairage Elec.," Nov. 17.

Fire in a Telegraph Building.—The article mentioned in the Digest, Dec. 8, is abstracted with illustrations in the Lond. "Elec.," Nov. 30.

ELECTRO-CHEMISTRY.

Lead-Dust Accumulator.—"Ind. & Iron," Nov. 30, gives an illustrated decription of this accumulator as it is being introduced in England. It is claimed that other attempts to use finely pulverized lead have been unsuccessful because the change into peroxide involves expansion, which destroys the plate by buckling; the process used is to mix the lead-dust with pumice stone powder in the desired proportion, then moisten this with water, producing a plastic material which is then placed into the grids; this has to be done quickly as the paste has a tendency to set; it is claimed that the inert pumice stone enables the active material to expand without destroying the plate; the time for forming is said to be only one-fifth of that required for the ordinary pasted plates, and the capacity is said to be from 3.32 to 5.2 ampere-hours per pound of electrodes, according to the rate of discharge; the rate of discharge given in the table corresponds to four hours for a minimum and ten hours for a maximum time of discharge, and in this respect it therefore does not differ from the other accumulators; these figures appear to be given by the maker; the accumulators have been used for train lighting in Germany since 1891.

Lead Cells.—Mr. Fery in "L'Elec.," Nov. 24, gives the results of some tests made with a spongy lead plate as the negative, and with a substitute for the objectionable peroxide plate as the positive, as he believes that most of the defects of an accumulator are due to the positive plates; he substitutes for this a carbon plate and uses chlorine as a depolarizer; theoretically such a combination should give 1.70 volts; in all the tests he used chloride of zinc as the exciter; among all the combinations which he tried the only one of interest was one in which the depolarizer was $Fe_2 Cl_6$ on account of the constancy; such a battery can be used to advantage in certain cases in laboratories, but its low E. M. F. prevents it from coming into general use; in these cells the resistance increases with the time.

Gas Battery.—An illustration to the paper abstracted in the Digest, Dec. 8, showing the apparatus, is published in "La Nature," Dec. 1; this illustration was not contained in the journal from which our abstract was taken.

Prussian Blue and Berlin Green.—The Goebel process of preparing these substances electrolytically is briefly described in the Lond. "Elec. Rev.," Nov. 30. A solution of yellow prussiate of potash is precipitated by means of a ferrous salt, such as green vitriol, the precipitate being suspended in water and then subjected to electrolysis, yielding Prussian blue; the solution may contain 0.05 per cent. of acid; the precipitate is introduced in the immediate neighborhood of the anode, the contents of both compartments being kept well stirred; the hydrogen liberated is taken up by manganese peroxide, or by organic nitro-compound; when the electrolytic action is protracted, the color becomes faint and the material changes to dark Berlin green.

Gold Extraction.—The Lond. "Elec. Rev.," Nov. 30, contains two more communications on the cyanide process, by Mr. Andreoli; in reply to Mr. Weightman (see Digest last week) he states that the objections to the use of carbon are more serious than that writer thinks; he also believes that the 600-ampere rate would be more efficient than the 60-ampere rate proposed by Mr. Weightman.

Galvanized Wire.—The "Elek. Anz.," Nov. 29, describes a process in which the wire is first passed through a nickel bath and then through a zinc bath, the object being to make the zinc coating adhere more tenaciously than it does with the ordinary hot galvanizing process.

MISCELLANEOUS.

Thermopiles.—In an article by Mr. Brueggemann in the "Elec. Zeit.," Nov. 29, he gives the results of a number of different measurements with the improved form of the Guelcher piles; each consisted of 66 elements, and one of them had been in constant use for two years. The results are given in curves and tables, and among the conclusions arrived at, the following may be given: The internal resistance was about 0.78 ohm; the maximum external output, he shows by experiment, is obtained when the external resistance is equal to the internal; the E. M. F. is directly proportional to the amount of gas used, between pressures from 11 to 34 mm of the water; he suggests regulating them by regulating the supply instead of by using external resistances; he finds that the counter E. M. F. produced by the current is very nearly proportional to the current, but it is so slight that the E. M. F. (as distinguished from the voltage at the terminals) may be assumed to be constant for all currents; he gives curves showing the gradual rise and fall of the E. M. F. after lighting or extinguishing the flame, and finds that the flame should burn about 24 minutes before the maximum E. M. F. is reached, although 90 per cent. of it is reached after 11 minutes; the internal resistance appears to increase with use, at first quite rapidly and then slower, finally becoming a constant; with a pressure of 30 mm of water the E. M. F. was 3.97 volts with a consumption of 164 liters per hour.

Welding.—The "Elek. Anz.," Nov. 18, publishes a few figures relating to the Lagrange & Hoho processes (sometimes called, in this country, the water-pail forge process, in which the metal is heated by immersion in a liquid, while a current passes); the voltage appears to have been 150, and the result referred to rods of iron; it is stated that the best current density was found to be about 32 amperes per sq in. of immersed surface, and the best temperature about 157 deg. F.; (it appears that the maintenance of this temperature is an important factor, as the action is not good when the temperature becomes too high); with an iron rod of 127 sq. mm cross section, the time was 61 seconds and the watt seconds per sq. cm was 691,000; for a cross section of 284 these figures were 80 and 661,300, and for a cross section of 150 they were 58 and 537,200.

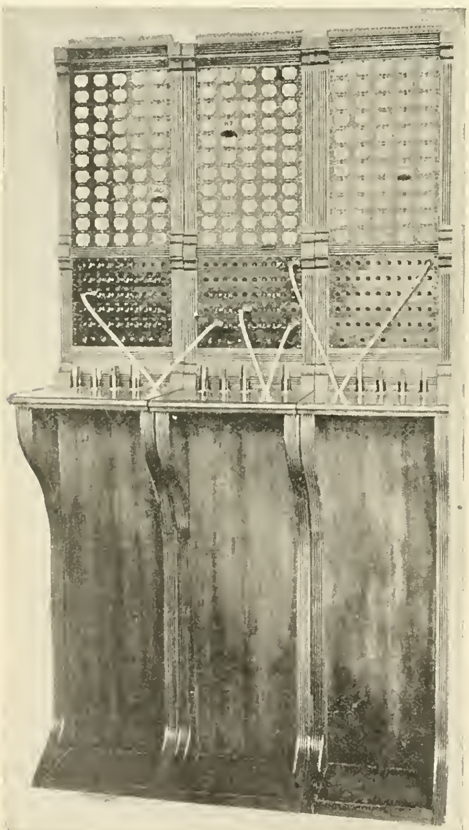
Movable Roof.—The electrical apparatus for operating a removable roof in an auditorium in Paris, is described with illustrations in "L'Elec.," Nov 24; the roof appears to be on wheels and is in two halves, each of which carriers its motor.

Lightning.—An illustration showing a peculiar freak of a bolt of lightning is published in "Cosmos," Nov. 17; the lightning appeared to have passed down the side of a house along a metallic water pipe, but instead of entering the ground it took apparently a much longer path along the wall, through the hinges of a shutter and thence to ground through an iron grating.

Tachometer. — A good illustration, with description, of a new and ingenious form devised by Mr. Amsler is published in "La Nature," Nov. 17.

Magneto Telephone Exchange.

The Niles Telephone Company, of Niles, Mich., has recently installed the system of the Gilliland Telephone Company, 186 Fifth avenue, Chicago. The plant was constructed by the Gilliland company and its magneto telephone and switchboard used throughout. Mr. Nate, General Manager of the company, who recently returned from Niles, reports that



Switchboard of Magneto Telephone Exchange.

the subscribers to the system are more than pleased with the service furnished.

The exchange was opened with 95 subscribers, and in a letter ordering ten additional instruments the local manager states that the system continues to grow in favor daily.

The switchboard, which we illustrate, embodies some entirely new features. It is simplicity itself, very accurate and remarkably rapid in its work. The board is of 150-wire capacity, being in three sections of 50 each.. The same design can be made in any capacity desired.

A Huge Alternating Generator.

The General Electric Company is now building at its Schenectady Works one of the largest alternating current generators ever constucted. The generator is to be installed at St. Louis, Mo., in the station of the Edison Electric Illuminating Company and will supply current for incandescent and arc lighting and for motor service.

In order to secure efficient results for these various uses, the generator is constructed on the "monocyclic" system, recently adopted by the General Electric Company. This system employs a comparatively low frequency of alternations, and the armatures of the generators have special windings adapting them for use on circuits with self-starting current motors.

The generator illustrated (Fig. 1) is of 800-kilowatts capacity, has 80 poles and is to be driven by a Hamilton-Corliss engine at 90 revolutions per minute. On account of the great size of the frame difficulties were to be expected in producing the castings, but thanks to the facilities of the Schenectady works, no trouble was experienced in pouring even the

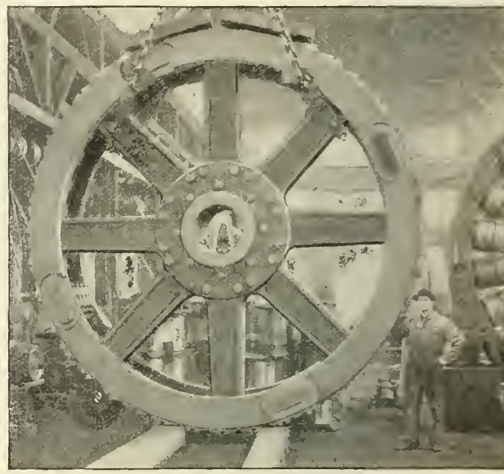


Fig. 1.—800-Kilowatt Generator.

large frame casting shown. This single piece, made up in part of wrought iron embedded in the castings, weighs 35 tons and measures 24 feet over all. The armature is ironclad and is 16 feet in diameter, weighing nearly 100,000 pounds. The armature will be supported on a 22-inch shaft.

Fig. 2 shows also the armature spider before the laminations were placed upon it. An idea of its size may be had by comparing the spider with the 400-kilowatt rotary converter which stands to the right of it.

The completed generator will supply, when at full load, 667 amperes at 1,200 volts, equivalent to 16,000 16-cp lamps.

In this connection it should be stated that the great size of the gen-

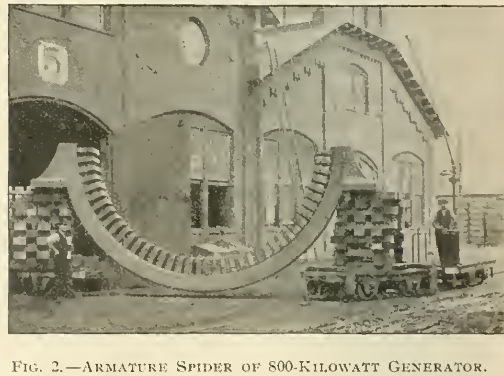


Fig. 2.—Armature Spider of 800-Kilowatt Generator.

erator was necessitated by the requirements under which the machine is to be operated, chief of which is the low speed of revolution.

Electric Traction in Dublin.

By the 1st of May next it is anticipated that the Dublin, Ireland, Southern Tramways Company will have an entire electrical equipment on its lines. The electric lines will consist of eight miles of double track, and the change will also involve an entirely renovated plant. New cars to be lit by electricity will be built.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Dec. 15, 1894.

ELECTRICAL STOCKS still fail to develop particular activity, but when note is made of the sluggishness pervading the whole Stock Exchange list, that ceases to be remarkable. The strength they continue to display is, however, in marked contrast to the weakness marking the course of other comparatively active steam railroad and "Industrial" shares and is the most convincing argument as to the healthy condition of the electrical trade.

GENERAL ELECTRC was a little more quiet this week than is ordinarily the case, but the lack of operations in the stock has not beeen at the expense of quotations. Prices are fully up to recent records, while the 5 per cent. bonds are in more demand than has been observable for some time. Their quotation has accordingly risen about ½ a point. There have been some efforts made to bull the stock on false reports relative to new combinations and agreements. One of these rumors had to do with an arrangement said to have been effected with the Westinghouse Electric and Manufacturing Company looking to the fixing of prices. Another report recently published had it that the Cataract General Electric Company, which has bought machinery from both the General Electric and Westinghouse companies was to be absorbed by the former. It is silly to attempt to boost General Electric stock on any such fake stories. There is enough intrinsic value in the stock to make it worth current quotations, and, once the existing complication in the company's financial status has been arranged for, the stock, to judge from its present shown ability to earn money, will be worth even a good deal more. But it were best in the meantime to let things take their natural course and not influence the stock's value by any such methods. The incident serves to show, however, how artificial the market really is and how little real significance there is in current affairs.

WESTINGHOUSE ELECTRIC common holds its own around 33. The stock was recently marked down on wash sales, but the fictitious character of the transactions were speedily recognized and the orders that made their appearance under 32 caused all offerings to be so freely absorbed that the price quickly went back to current figures. There is no reason for a break in the stock's quotation. The company's business is perfectly satisfactory. It is getting new contracts every week and the outlook is understood to have never been more promising than it is at present. The scrip, too, has risen in value the bidders having been obliged to raise their offer to 97. The preferred shares are now selling ex-dividend but are strong.

WESTERN UNION TELEGRAPH'S statement of earnings and expenses for the last quarter makes a good comparison with the figures for the same period in 1893. All figures are partly estimated, but the statement shows that net earnings inscreased $50,000, the total being estimated at $1,600,000. The actual may be more as the net earnings for the September 30 quarter were $13,563 more than the estimate. Dividends increased $7,000 but the surplus of $165,200 is none the less $43,462 more than was left over in 1893 after making similar provisions. Of course, in view of these improved earnings, the regular dividend of 1¼ per cent. was ordered paid on the stock. A director of the company is quoted as saying after the meeting that the improvement "was due in great part to the larger business South, where earnings have run ahead of 1893. In the West, there has been some improvement, although not as much, while in the East results have been relatively not as good. It is rather an interesting fact that the leased wire business has been better than it was a year ago. There has been quite a demand for this form of telegraphic facility." Knowledge of the favorable character of the report led early in the week to good buying of the stock.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	127	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	102½	103
" " " Brooklyn	100	109	112
" " " Boston	100	127	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	39	40
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	34⅞	35
General Electric, pref	100	70	72
Westinghouse Consolidated, com.	50	33	34
" " pref	50	51	51½

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	109	110
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	91¼	91½

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	200	201
American District Telegraph	100	35	40
American Telegraph & Cable	100	91	92
Central & South American Telegraph	100	102	105
Commercial Cables	100	130	145
Erie Telephone	100	52	53
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
Western Union Telegraph Ex-div.	100	88½	89
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55

AMERICAN BELL TELEPHONE surprised the financial world by declaring, in addition to the regular quarterly dividend of 3 per cent., payable January 15, an extra one of 1½ per cent. The extra dividend is officially declared "payable out of the surplus earnings of the six months ending December 31." Up to July, 1892, the company had been paying an annual extra divided of $6 per share in July for three years. Beginning with July, 1892, it paid $3 per share extra in January and July up to July, 1894, when no extra dividend was paid, but at the declaration of the next quarterly dividend in September last, an extra dividend of 1½ per cent was declared payable out of earnings of the previous six months. In view of this extra dividend of 1½ per cent. last quarter, payable out of six month' earnings, with no extra dividend since 3 per cent. last January, the street hardly expected anything at this juncture and the 1½ per cent. extra was a gratifying surprise. This extra payment makes 15 per cent. for the year, but the payment of 1½ per cent. extra for two successive quarters gives hopes that the old basis of 18 per cent. per annum will be returned to.

THE FORT WAYNE ELECTRIC CORPORATION'S 6 per cent. debentures, for which the old Fort Wayne Electric stockholders subscribed, are being issued to those who paid subscriptions in full. A dividend of 12 cents a share will, it is announcd, be paid January 1st, upon Fort Wayne Trust securities, Series A.

STREET RAILWAY AND ILLUMINATING PROPERTIES common stock rules very strong at 22 bid with one small sale reported at 23. Of the preferred stock, 81,337 shares have been retired to date, $105.72 being paid for the last lot. This leaves 26,863 shares outstanding, which can be drawn at 110. The company is reported to have $200,000 in bank, and it is figured that common stockholders will receive from $40 to $50 per share in the final wind up.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, reports as follows for November. Gross earnings, $145,904, an increase of $24,202 over the gross receipts for November, 1893; operating expenses and taxes $63,613, increase $7,497; net earnings $82,290, increase $16,704. Gross earnings for eleven months are $1,256,016, an increase of $157,647; net earnings $645,782, increase $139,072; accrued interest on bonds, $189,300, the amount of outstanding bonds having increased $750,000 from $3,562,000 to $4,312,000; amount applicable to dividends on $7,938,000 capital stock, $456,482, a decrease of $20,249. The number of incandescent lamps in use at the end of November was 229,471, a gain of 46,406, and arc lamps 3,005, a gain of 682.

BROOKYLN EDISON ILLUMINATING reports $50,018 gross earnings for November; this is $10,088 ahead of last year. Net earnings were 26,109, an increase of $5,615, and the amount applicable to dividends is $28,029, an increase of 8,058.

ERIE TELEPHONE stock is quiet. Net earnings for October are reported to have increased $8,410 over the same month last year.

EDISON ILLUMINATING OF BOSTON is very strong. The stockholders vote December 18 upon a proposition to increase the capital from $425,000 to $3,425,000, the money to be used for improvements and extensions.

THE TRACTION STOCK MARKET is lacking in particular news, speaking from a trading standpoint, though each day brings new evidence of the ever-increasing interest being taken in this class of securities. The various stock exchange authorities are recognizing the demand for traction stocks and are affording increased opportunities for trading in them. The Philadelphia Exchange has given a listing to $3,000,000 common stock and $2,200,000 first mortgage 5 per cent. bonds of the Columbus (Ohio) Street Railway Company and the New York Stock Exchange listed the bonds of the Denver Tramway Company. The electric street railroad has come to be a tremendous factor in the commercial and financial worlds, and its use is daily extending. Earnings of late on many important Eastern systems are reported as falling off a little; the bad weather is responsible for this and quotations are not affected by the showing.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	66	69
" " common	14½	15½
Long Island Traction	14	14½
Rochester St. Ry	38	40
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction	22	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	107¼	107½
Philadelphia Traction	101	101½
People's Traction	55	55½

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. m. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	95	97
Binghamton Railroad Co. 5s	99	100

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Dec. 15, 1894.

MR. FRANK RIDLON, of Boston, was in the city last week.

MR. C. W. HOLTZER, of the Holtzer-Cabot Electric Company, of Boston, paid a visit to this city last week.

MR. CHARLES HUNTLEY, of Buffalo, was registered at the Waldorf last week.

MR. A. MITCHELL HALL, general manager of the C. & C. Electric Company, 143 Liberty street, has gone West on a business trip.

MR. L. WARFIELD, of the Detroit Electrical Works, was in New York during the week, and called at the office of The Electrical World.

MR. J. W. GODFREY, formerly manager of the New York Insulated Wire Company, 15 Cortlandt street, New York, has taken offices at the same address, room 38.

MR. WILBUR F. HANKS, advertising representative of the "Electrical Engineer," has just returned from Willimantic, whither he had gone to attend the funeral of his brother.

MR. W. H. McKINLOCK, the enterprising president of the Metopolitan Electric Company, Chicago, visited the office of The Electrical World while on a business visit to the East during the present week.

MR. J. A. MACHADO, 203 Broadway, New York City, sole selling agent of Waddell-Entz dynamos and motors, has been awarded the contract for the light and power plant for the new building of the New York Clearing House. Direct connected generators will be used.

THE RECENT DEATH of Mr. W. E. Kelly, president of the National Water Tube Boiler Company, of New Brunswick, N. J., removes a familiar figure from business circles, and one whose loss will be much regretted by an unusually extended circle of friends.

DAVID CHALMERS, 114 Liberty street, New York, agent of the Holtzer Cabot Electric Company, Boston, met with a painful accident last week. Whilst closing his safe his right hand was caught in the jams of the door and so injured as to render the hand useless for some time.

MR. C. O. BAKER, JR., master of transportation of the National Electric Light Association, has just returned from a four weeks' trip in the West and North, and states that every one is enthusiastic over the coming electric convention to be held in Cleveland, and that the indications are that it will be the largest ever held.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 44 Broad street, New York, reports that the American Electric Supply Company, of Buffalo, N. Y., has ceased to be its agent. The American Electric Supply Company, it states, is one of the oldest agents of the Conduit company, and the relations between the two companies have always been of the pleasantest character. The Conduit company, however, has found that its interests are antagonized when represented by a construction house, and have consequently changed its policy and in the future will be represented by supply houses not engaged or financially interested in the construction business. The American Electric Supply Company could not afford to give up the large construction business it enjoys, and hence followed a friendly termination of its agency relations with the Interior Conduit and Insulation Company.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago,
December 15, 1894.

THE NASHOLD CLEAT, manufactured by the Nashold Cleat Co., Chicago, continues to grow in favor, if the inquiries and orders from all parts of the country are any evidence. Nearly every city in the nation has sent requests for samples of this clever device.

PROF. J. P. BARRETT returned during the week from a trip east. The new city lighting contract has not been let as yet, but the Professor promises that things will be all right in a very short time. He is enjoying good health and is as jolly as ever.

W. H. McKINLOCK, another of Chicago's leading citizens, returned from the east during the week. It is curious that a man who is always busy in Chicago cannot remain away any great length of time. Mr. McKinlock is no exception, for he is kept right at it with the ever-increasing business of the Metropolitan Electric Company.

MR. F. A. HAMILTON, member A. I. E. E., recently gave an interesting lecture before the electrical students of Armour Institute on the subject of "Submarine Cables and Cable Laying." It was fully illustrated by lantern slides, made from original sketches and charts. Mr. Hamilton was for sixteen years Electrician in Chief to the Anglo-American Telegraph Company.

THE NUTTING ELECTRIC COMPANY is pleased to announce that all internal differences have been settled, and it is now in a position to offer its friends and the electrical trade the perfected Nutting arc lamp. This, it claims without fear of contradiction, will be found the best alternating arc lamp on the market, and it has issued a handsome pamphlet describing the lamp in detail. The address of the company is 128 South Clinton street.

THE CENTRAL ELECTRIC COMPANY seems to display the qualities of the evergreen. By degrees its great store on Adams street has become more and more settled until it is now in admirable working order. Everything is so arranged that an order goes through its course with certainty and swiftness, and details are so nicely taken care of that nothing goes amiss. Its new supplementary catalogue contains many new and valuable additions to what is conceded to be one of the best lines of supplies and specialties ever arranged under a single house.

THE DEARBORN ELECTRIC COMPANY, of Chicago, has succeeded to the business of T. C. Rafferty & Company, and in the new and commodious quarters which it has secured at 19 Quincy street, opposite the Great Northern Hotel, it will be better able to handle promptly the largely increasing business of the past few months. The officers of the new company are as follows: T. C. Rafferty, president; Chas. Merser, vice-president and treasurer, and J. P. Rafferty, secretary. A new illustrated catalogue is in the hands of the printer at the present time which covers fully the various valuable agencies which the company has, as well as a full line of general supplies.

News of the Week.

New Incorporations.

THE AVALON ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $500.

THE BEN AVON ELECTRIC LIGHT COMPANY, Ben Avon, Pa., has been incorporated with a capital stock of $500.

THE BEAVER AND GLADWIN TELEPHONE COMPANY, Gladwin, Mich., capital stock $250, has been incorporated by Eugene Foster, J. M. Schaffer, S. S. Towusend and others.

THE TREMONT IMPROVEMENT COMPANY, Portland, Me., capital stock 1,000, has been formed to build and operate an electric light, heat and power plant. The interested parties are Howard L. Rogers, Charles F. Wallace, Boston, Mass., and Josiah H. Drummond, Jr., Portland, Me.

THE CASTLE ROCK ELECTRIC COMPANY, Castle Rock, Wash., capital stock $1,000, has been formed to operate an electric light and power plant. The promoters are C. E. Forsythe, A. S. Forsythe and H. V. Gates.

THE VALPARAISO GAS AND ELECTRIC COMPANY, Valparaiso, Ind., capital stock $120,000, has been formed to supply gas and electric lights. The incorporators are Jesse Scribner, Otis E. Turner and Oscar H. Olsen.

THE CHATHAM ELECTRIC LIGHT AND POWER COMPANY, Savannah, Ga., capital stock $25,000, has been formed to operate an electric light and power plant. George Parsons, Henry Parsons, James J. Johnson and John N. Harriman are the promoters.

THE PEOPLES' ELECTRIC RAILWAY, Terre Haute, Ind., capital stock $100,000, has been formed to construct and operate an electric railway. Andrew J. Crawford, James P. Crawford, George J. Hammerstein, Edwin Ellis and Herman Halman, Sr., are the promoters.

THE KEOSAUQUA CANAL AND WATER POWER COMPANY, Keosauqua, Ia., has been formed to utilize a water power and maintain same for generating electricity, or compressed air. Ben Johnson, W. M. McIntosh, H. E. Duckworth, C. W. Casner and James Anthony, Keosauqua, are the organizers.

THE DENISON ELECTRIC LIGHTING AND POWER COMPANY, Denison, Iowa, capital stock $20,000, has been formed to establish and maintain an electric light and power plant at Denison. J. B. Romans, E. Culick and J. N. Bradley, Denison, Iowa, are the promoters.

THE NIAGARA ENGINEERING COMPANY, Model City, N. Y., capital stock $10,000, has been incorporated to build and equip electric light, railway, heat and power plants, and to make and sell the necessary apparatus. L. B. Dorr, C. C. W. Nobles and L. E. Squier, of Buffalo, N. Y., are interested.

THE PADUCAH ELECTRIC COMPANY, Paducah, Ky., capital stock $40,000, has been incorporated for furnishing arc and incandescent electric lights, power for motors, elevators, etc. Elbridge Palmer, R. Rowland, J. L. Friedman, J. W. Keiler, W. A. Gardner, F. M. Fisher and A. E. Einstein are interested.

THE NEW MEXICO ELECTRO-CHEMICAL REDUCTION COMPANY, Chicago, Ill., capital stock $100,000, has been formed to mine, reduce, refine and treat ores and minerals bearing gold, silver or other precious metals. The organizers are Otto R. Barnett, Clenn C. Plumb and Clark Edward Ridpath.

THE FERRIS ELECTRIC AND MANUFACTURING COMPANY, Cedar Rapids, Iowa, capital stock $10,000, has been formed to make, buy, sell, lease and repair electrical apparatus or appliances and to equip and operate same. W. J. Ferris, Chicago Ill.; Thomas Ferris and Robert Ferris, of Cedar Rapids, are the interested parties.

THE PHOENIX ELECTRIC SUPPLY COMPANY, Warren and Youngstown, O., capital stock $1,000, has been formed to deal in electrical supplies of all kinds, to manufacture electric lamps, and to supply electric light and power, etc. Warren B. Swager, Warren L. Swager, Wm. F. Corbin, Herbert H. Miller and David W. Campbell are the promoters.

THE TRENTON TRACTION COMPANY, Trenton, N. J., capital stock $500,000, has been incorporated by E. J. Moore, Philadelphia, Pa.; Thomas C. Barr, Newark, and Francis M. Eppley, of Orange, N. J., and others, for the purpose of leasing and operating the lines of the Trenton Passenger Railway Company, which controls franchises in nearly every street in the city.

THE PHOENIX ELECTRIC SUPPLY COMPANY, Warren, O., capital stock $1,000, has been incorporated by Warren B. Swager, Warren T. Swager, William F. Corbin, Herbert M. Miller and David W. Campbell, to deal in electrical supplies and incandescent electric lamps; also to act as agent in selling for others electric lamps and supplies of all kinds, and in general to engage in the business of dealing in electric lamps and supplies.

THE NEW JERSEY AND DELAWARE ELECTRIC FORGING COMPANY, Newark, N. J., capital stock $250,000, has been incorporated to rent, furnish and lease apparatus for forging, welding, heating, etc., iron, steel, copper or other metals through the medium of electricity in a liquid solution, etc. Frederick A. Nichols, Arlington, N. J.; Barnard J. Fredericks, New York, and Edward Kenny, Newark, N. J., are the organizers.

Telegraph and Telephone.

RICHMOND, VA.—Samuel Regester and associates have applied to the city for a telephone franchise.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company will remodel and improve its plant.

MARSHFIELD, WIS.—The National Telephone Company has just completed the work of putting in an exchange.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company will enlarge and otherwise improve its plant.

GRAND RAPIDS, MICH.—The Harrison Telephone Company has applied to the Council for a franchise to build lines in Detroit.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is making extensive improvements in Montana, among them being the construction of 30 miles of double circuit lines to Marysville.

GOSHEN, IND.—F. L. Middleton, of Elkhart, will meet a committee from the Common Council at Goshen in reference to establishing a new telephone exchange at that place similar to the one contemplated at Elkhart.

ASBURY PARK, N. J.—A local telephone company will be organized in Asbury Park. At a meeting of subscribers this course was unanimously decided upon. The new company will have a capital of $25,000. Mayor Ten Broeck may be addressed.

LOCKPORT, N. Y.—The Citizens' Mutual Telephone Company has been organized to construct a telephone line between Lockport and Niagara Falls. The capital is $15,000, and the directors are Joseph A. Ward, Wm. V. Trevor, Hiram K. Wickes, Theo. H. Van Horne, and others of Lockport.

FULTON, N. Y.—The Fulton Valley Telephone Co. has been organized to connect Middleburg with Fulton, Fultonham, Breakabaen, and Blenheim, all in Schoharie County, by telephone. The capital is $500, and the directors are Albert L. Rosekrans, Charles W, Vrooman, and Charles Bouch, of Fulton, and others.

Electric Light and Power.

EUFALA. ALA.—Address the Mayor regarding the establishment of an electric light plant.

CLINTONVILLE, WIS.—Address the city clerk concerning an electric light plant to be established.

MEMPHIS, MICH.—Thomas Clegg, of Memphis, is interested in establishing an electric lighting plant.

HEMPSTEAD, TEX.—It is reported that an electric light plant and a water works system will be built.

MERRILL, WIS.—The Merrill Railway and Lighting Company is adding a new $10,000 storage battery.

NEOSHO, MO.—Owen Ford, of St. Louis, who lately obtained an electric light franchise, is arranging to erect a plant.

THOMASVILLE, GA.—The Thomasville electric light plant has been purchased by John H. Davidson and Remur McIntyre.

HAMMOND, LA.—W. D. St. Clair is to establish an electric light plant, and a portion of the machinery has already been purchased.

BAYFIELD, WIS.—Bayfield City has come into possession of the water and electric light companies, both being purchased by the city.

CUMBERLAND, MD.—One of the buildings which the Baltimore & Ohio Railroad Company is constructing will contain an electric power plant.

FAYETTEVILLE, N. C.—It is reported that the Council is considering the question of lighting the streets by electricity. W. S. Cook is Mayor.

OSHKOSH, WIS.—E. E. Stevens, W. F. Grunewald and F. H. Josslyn are looking for a site for the location of J. K. Tillotson's new power house.

ANDERSON, S. C.—The Anderson Electric Light and Power Company has purchased water power at High Shoals, and will remove its plant to that place.

GREEN BAY, WIS.—The Green Bay & Ft. Howard Electric Light Company has filed an amendment to its articles increasing its capital stock to $60,000.

ROCHESTER, N. Y.—The Board of Supervisors have authorized the Committee on Courthouse and Jail to procure estimates for an electric lighting plant.

WEEDSPORT, N. Y.—The Board of Trustees of Weedsport has granted a franchise to an electric light company, which agrees to furnish 35 arc lights for $1,500 per year.

MOORESTOWN, N J..—The Moorestown Electric Light Company has issued a notice to its patrons to the effect that, after January 1, the price of light would be increased 25 per cent.

COEYMANS, N. Y.—Plans are in preparation for the erection of an electric light pant and an electric railway from this place to Rensselaerville, and a proposed further extension to New Baltimore.

MONROE, MICH.—At a meeting of the Common Council bids for lighting the city by electricity were opened. The contract was let to the Monroe Gas Light Company. The new plant will be installed by them.

WINEMAC, IND.—The Winemac Electric Light & Power Company has been incorporated with a capital stock of $10,000. J. H. Weaver, I. V. Smith, E. A. Clelland, M. A. Dills and George Muns, are interested

DUNMORE, PA.—At the Council meeting a communication was received from the Electric Light Company offering to provide all night lights at 25 cents each provided the borough would enter upon a five years' contract.

E. ORANGE, N. J.—The building which Mr. W. H. Allen will shortly erect on Harrison street, corner of the railroad, is to be lighted by electricity from a dynamo on the premises. Mr. S. W. Whittemore is the architect.

IRVINGTON, N. J.—Citizens are talking of organizing a company for the purpose of supplying the village with electric light and power. A majority of the business men and taxpayers favor arc lights for the center of the village.

LESTERSHIRE, N. Y.—At a meeting of the trustees of the village, the advisability of erecting its own electric light plant was considered, but they concluded that it would be economy to obtain the lighting from the plant in this city.

HAMILTON, MO.—An informal meeting of the City Council was held, and the subject of electric lights for the city discussed and favorably considered. The conclusion was reached, however, that the matter would have to be submitted to a vote of the people in order to give the Council proper authority to grant a permanent franchise, and provide funds for the payment of contingent expenses.

LYNCHBURG, VA.—The City Council, at its meeting, rescinded its recent action granting a five years' contract to the Lynchburg Electric Company for lighting the city, and referred the matter to a committee to advertise for new bids. This question has created an excitement in the community, it having been alleged that influences had been brought to bear by the Lynchburg Company to secure the contract. Electrical experts from various sections of the country have figured in the controversy.

The Electric Railway.

CHESTER, PA.—The Chester and Media Electric Railway ordinance has been adopted.

BALTIMORE, MD.—The City Passenger Railway Company will ask permission of the City Council to extend its tracks.

MORRISTOWN, N. J.—Citizens of Morristown are talking over a proposition to build a system of street car lines in that city.

RUTHERFORD, N. J.—The Union Traction Company has made a formal application for a franchise to the Union Township Commissioners.

SYRACUSE, N. Y.—The Syracuse Street Railway Company will erect a new power house on Tracy street to cost $20,000.

RENNSELLAERVILLE, N. Y.—A company proposes to construct a rural electric road from Rennsellaerville to Ravenna, a distance of 20 miles.

PADUCAH KY.—The Paducah Electric Company has purchased the Citizens' Railway, and it is stated, will rebuild it as a trolley road. Eldridge Palmer and R. Rowland are interested.

PALMYRA, N. J.—The Township Committee has issued a call for a meeting of the citizens to consider the application of the West Jersey Traction Company for right-of-way through the town for a trolley line, which it proposes to operate between Camden and Florence. The consents of the property owners have been secured.

PROVIDENCE, R. I.—At a meeting of Common Council a report was received from the Committee on Railroads relative to a cross town line on the west side. In it was stated that the Union Railroad Company favors a belt line.

FALL RIVER, MASS.—F. W. Stevens and others have petitioned for authority to construct a street railway between Fall River and Providence, to be operated by electricity.

NIAGARA FALLS, N. Y.—A meeting has been held by the promoters of the scheme to run an electric road along the bank of the river to Lewiston, and the initial steps taken to secure right of way.

DETROIT, MICH.—The Detroit Railway Company has been granted a franchise by the Common Council to construct and operate about 20 miles of electric street railway. It will commence work at once.

BALTIMORE, MD.—The Baltimore Traction Company is considering the idea of extending one of its divisions to Clifton Park. Hon. Frank Brown is president.

PITTSBURGH, PA.—A new electric road is to be built from East Ohio street to Spring Hill, Allegheny. H. W. Ahlers, W. H. Hespenheide and others are stockholders.

NEWARK, N. J.—The Suburban Traction Company is in the hands of a receiver, Watson Whittlesey. It has an indebtedness of $1,500,000, and its principal creditor is the American Loan & Trust Company, Boston.

SEVERN, MD.—The Baltimore, Severn Park & Annapolis Electric Railway Company will locate its power plant at Severn Park. The incorporators are Henry Y. Brady, G. H. White and David S. Collett, of Baltimore.

LA CROSSE, WIS.—Rev. Father White, S. W. Anderson, H. J. Hogan and others met with Messrs. Cargill, Edwards and Gund, of the street railway with regard to extending the railway on Market street to the Catholic Cemetery.

WINDSOR, N. Y.—There is some talk of connecting Windsor and Binghamton with an electric road. Joseph Gardam, of New York, is obtaining signatures of Jefferson property holders for the right of way for a proposed electric railway.

BALTIMORE, MD.—John Hubner, of Catonsville, is among the capitalists interested in building an electric road from Baltimore to Cantonsville and Ellicott City, under the title of the Edmondson Avenue, Catonsville & Ellicott City Road.

HINSDALE, VT.—There is a strong feeling in Hinsdale favoring an electric railway from that place to Brattleboro, and in all likelihood an application will go to the Legislature this winter for one to be authorized from Ashuelot to this place.

NEW HAVEN, CONN.—The New Haven Street Railway Company is negotiating for the purchase of the Edgewood Avenue Company's lines, which consist of about seven miles of tracks. The price fixed is said to be between $100,000 and $125,000.

BALTIMORE, MD.—The City & Suburban Railway Company has permission to extend its York Road electric line through the northeastern suburbs to Homestead, near Clinton Park. The distance is about one mile. Nelson Perin is president.

GREENSBURG, PA.—A franchise has been granted by the Borough Council to the Greensburg, Jeanette, Turtle Creek & Pittsburg Electric Street Railway Company for right of way through Greensburg. The capital stock of company is $150,000.

DE LAND, FLA.—A stock company is to be organized to build an electric road between De Leon Springs, De Land and Orange City, and the citizens of De Land are to subscribe $40,000 of the stock. About 150 shares of the stock have been taken.

NORRISTOWN, PA.—The Shepp Bros., who have begun work on the extension of their trolley road from Norristown to Royersford, have secured a franchise from the Perkiomen and Reading Turnpike that practically gives them the whole route.

NIAGARA FALLS, N. Y.—The Cataract Electric Company is to have a trolley system constructed from Niagara Falls to Tonawanda early in the spring, and inventors of the different methods of propulsion by electricity will be invited to test their schemes.

THE SIDNEY ELECTRIC RAILWAY COMPANY, Sidney, O., capital stock $100,000, has been formed to construct and operate a railway in Sidney, thence to Loramies, thence to Minster, O. Charles Timeus, John Loighlin, I. H. Thedieck, William Piper and John H. Wagner are the interested parties.

ANDERSON, IND.—The Gas Belt Electric Street Railway Company has awarded a contract to a Chicago company for the construction and equipment of the electric road, and are bound by contract to have it ready for operation by the 15th of August, 1895.

SEDALIA, MO.—D. C. Metsker, Superintendent of the Electric Railway, Light & Power Company, has stated that it will build nearly -three -miles of line early in the spring of 1895, which will be an extension of the present road. No contracts have been let as yet.

FORT WORTH, TEX.—Morgan Jones, Vice-President of the Fort Worth Street Railway Company, has stated that the company will rebuild most of this line, also the North Side road, and relay them with 56-pound steel rails. About 13 miles of line will be covered in this way.

BATAVIA, N. Y.—Batavia may have a street railway. The Aldermen have decided to give A. B. Wilgus a franchise for the construction of an electric street railway in Batavia, and Mr. Wilgus promises to have at least three miles of road constructed and in operation within a year.

NILES, O.—The Mahoning Valley Electric Railway has been incorporated with a capital stock of $150,000. The road will run from Niles to Youngstown, passing through Girard, with headquarters at Niles. G. E. Harrick, Andrew Squire and A. Anderson, of Cleveland, are the incorporators.

POTTSTOWN, PA.—The Ringing Rocks Electric Railway Company, which now runs to Ringing Rocks, three miles north of Pottstown, is making preparations to extend its line to Boyertown by way of the Limerick and Colebrookdale turnpike. The extension will be completed early next spring.

DETROIT, MICH.—A number of Detroit capitalists and pushers of new ideas have quietly formed a syndicate for the purpose of building an electric railway from the dividing line between Wayne and Oakland Counties, through Birmingham to Pontiac. E. W. Voigt, the brewer, is at the head of the syndicate.

THE GRANT STREET ELECTRIC RAILWAY COMPANY and the Raimer Avenue Electric Railway Company, both of Seattle, Wash., are now operated under the management of Receiver W. J. Grambs, the Seattle representative of the Northwest General Electric Company.

CRAWFORDVILLE, IND.—A contract has been closed between the Anderson & Marion Electric Railway Company, and C. E. Loss & Co., Pullman Building, Chicago, for building the line for $525,000. It will connect towns having 75,000 population, passing thorugh Alexandria, Gas City, Somitville and Fairmont.

ELIZABETH, N. J.—The New Jersey Traction Company has finally secured a franchise from the Clinton Township Committee of Newark to lay tracks in the center of Frelinghuysen avenue, to connect with the Elizabeth branch. The construction of the road from Newark to Elizabeth will be begun at once. It is now thought that Elizabeth will have trolley cars before February 1.

BALTIMORE, MD.—G. Howard White, H. T. Brady, and David S. Collett, of Baltimore, are interested in forming a company to build an electric road from Baltimore to Annapolis, by way of Severn Park. The trolley system will be used, and $250,000 placed as capital of the company. The distance is about 28 miles.

NEWTON, MASS.—It is given out on excellent authority that the West End road can at last see its way clear to establish a circuit street railway system from Boston through Cambridge and Watertown to Newton, and returning from the latter point through Brighton aud Alliston and over the Brookline boulevard to Boston.

WARREN, O.—John E. McVey has been granted a franchise by the Trumbull County Board of Commissioners, for the construction and operation of a line of electric street railroad from Niles to the Southern line of the county. The road is to be in operation by Sept. 1, 1895, and the power-house is to be located in Trumbull County.

ENGLEWOOD, N. J.—The electric railway which is projected from the ferry to Englewood, an entirely new enterprise, is now being surveyed by the engineers in order that the most feasible route up the hill may be established. This portion of the line is indepeudent of the surface connections which have already been determined upon.

THE STATEN ISLAND ELECTRIC RAILROAD COMPANY, New Brighton N. Y., capital stock $1,250,000, has been formed to build, maintain and operate a street surface railway 22 miles long in Richmond county, N. Y. The interested parties are George B. M. Harvey, Milton L. Boudon and Eugene R. Leland, all of New York.

THE BARNES HEIGHTS AND CORNELL MOUNTAIN ELECTRIC RAILROAD, in Portland, Ore., recently went into operation again, after having been shut down for some time. Current is taken from the wires of the Portland Consolidated Street Railway Company's system, which is generated at the Union Power Company's central station.

SAN FRANCISCO, CAL., citizens are agitating the formation of an organization to prevent the monopolization of the streets by the Consolidated Railway Company through its numerous franchises. The trolley system in general is also opposed by many citizens on account of the numerous accidents common to surface roads in large cities.

THE OLYMPIA LIGHT AND POWER COMPANY, of Olympia, Wash., recently purchased the following from the Northwest General Electric Company for the equipment of its new electric railway line, which will be used to transport material to the new State Capitol building now being erected in Olympia. One 30-hp freight car, with two G. E. 800 car equipments, with type K controllers, and new line material sufficient for one mile of new trackage.

THE BROOKLYN, NEWTOWN AND BOWERY BAY ELECTRIC RAILWAY received a franchise on December 12 from the Board of Highway Commissioners of the township of Newtown, for the construction of an electric railway from Greenpoint to the Lutheran Cemetery and Bowery Bay. About ten miles of track will be constructed and twenty cars operated. The president is A. C. Combes, of Newtown,and the engineer E. B. Gallaher, 253 Broadway, New York, who is also the engineer of the new Peekskill road

TRENTON, N. J.—The Trenton Traction Company has been incorporated with a capital of $500,000. Among the incorporators named are E. J. Moore, the head of the Philadelphia Traction Company, and Thomas C. Barr, formerly head of the Consolidated Traction Company, of Newark and Jersey City. The new company will lease the lines of the Trenton Street Car Company.

COLUMBIA, PA.—At a regular monthly meeting of the Borough Council it was resolved that whenever the Columbia, Ironville & Mt. Joy Street Railway Company demonstrates its purpose and ability to construct the proposed railway, and complete it to the borough lines, the Council will grant it such reasonable street franchises as are necessary for its business and accommodation.

CAIRO, N.Y.—An electric railway project is being pushed at Cairo. The Road Commissioners called a public meeting in order to find whether it would meet a favorable reception. Joseph Gardam, of 98 John street, New York City, representing a number of capitalists, was present to explain the matter, and an attempt is being made to secure the consent necessary to the issuing the franchise.

RAVENA, N. Y.—Considerable interest is being manifested in the villages along the thoroughfare running through the towns of Coeymans, Westerlo and Rensselaerville, in regard to the proposed electric road from the latter place to Ravena, a distance of 20 miles, and connecting with the West Shore Railroad. It is understood that Mr. F. C. Huyck, of Rensselaerville, is one of the prime movers.

FLUSHING, L. I.—A petition has been signed by property owners on Amity street protesting against the board of trustees granting permission to any railroad to lay tracks, string wires, or run cars on that street. The protest is the result of the fact that at the last meeting of the trustees the Flushing & College Point Electric Railway Company made application to extend its lines through the village.

PITTSBURG, PA.—It is said that a new street railway is contemplated between this city, Verona and Oakmont, and it is reported that the Duquesne Traction Company has its eye on the franchise, and also that the Citizens' Line is after the same thing. The Sharpsburg Passenger Railway is pushing its lines towards the coveted boroughs, and they may get in ahead of either of the two companies.

NEWBURGH, N. Y.—At a meeting of the Commissioners of Highways the application will be considered of the Walden & Orange Lake Railroad Company, for permission to construct and operate an electric railroad over the South Bank road from the western end of the Newburgh & Orange Lake Electric Railroad to the boundary line of the town of Newburgh and the town of Montgomery, a distance of about 1½ miles.

NEW BRITAIN, CONN.—The Central Railway & Electric Company has awarded to Redfield & Sons, of New Haven, the contract for grading and filling in the line to Berlin. A contract was also awarded to Frederick T. Lay, of Springfield, Mass., for laying the track and ties for the new road. All this work is to be pushed to completion as soon as possible. Engineer Caldwell surveyed another route for the electric line to Hartford, going straight out East Main street, etc.

BROOKLYN, N. Y.—The Batavia & Northern Railway Company was incorporated to construct a railroad eighteen miles long, to be operated by steam or electricity, between Albion, Orleans County and Batavia, in Genesee County. The capital is $352,000 and the directors are: Geo. A. Wingate, Jacob Cole and Wm. H. Hazard, of Brooklyn; Robert Avery and James H. Cox, of New York City; Ernest Wende, of Buffalo, and others. The principal office of the company will be in Brooklyn.

WAUKEGAN, ILL.—The Bluff City Electric Railway Company has completed its organization with Homer Cooke, president, T. H. Lindsay, treasurer, S. D. Talcott, secretary, H. Cooke, G. R. Lyon, S. D. Talcott, N. A. Steele, H. F. Powell, W. H. Dodge and T. H. Lindsay, directors. The capital stock is $200,000 and a few shares are already subscribed. The company intends to secure the right of way and build the system itself, if possible, or assist any responsible party to build it, that the city may secure the benefits of rapid transit.

CRISFIELD, MD.—A company was incorporated by the last legislature and a charter granted to lay off and construct a railway to commence at the railroad pier at this place and extend to a point on Pocomoke Sound at or near Sterling's Point, a distance of two and a half miles. A meeting of the incorporators has been held and T. S. Hodson was elected president, O. P. Byrd, secretary, and Isaac H. Tames, A. Lincoln Dryden and W. A. Tull, directors. Offers have been made by a syndicate in New York to construct and equip the road. It is thought that electricity will be used.

LOCKHAVEN, PA.—At a meeting of the citizens of Nippenose Valley, held Tuesday evening, in the interest of the proposed new trolley line, officers and directors were elected as follows: Directors, G. W. Clark, Sr., Levi Gann, Jonas Moore, Henry G. Eck and others. Officers: J. B. Denworth, president; Jonas Moore, secretary; John Engler, treasurer. Resolutions were passed that in building the road through Nippenose Valley, it be located to connect with and pass through Jamestown, Oval and Collums, to the central part of the Valley.

LANCASTER, PA.—Application will be made to the Governor of Pennsylvania on Dec. 18th by John J. Patterson, William B. Given, J. Hay Brown, John S. Skiles, Silas M. Patterson and others, for a charter for an intended incorporation to be called the "Keystone Traction Company," the character and object of which is the construction and operation of motors and cables, or other passenger railways, and the necessary apparatus for supplying the same, and of contracting with passenger railway companies to construct, lease and operate motors, cables and other appliances necessary for the traction of their cars.

BENNINGTON, VT.—The bills for a charter for the Bennington Electric Railway and the Bennington and Woodford Electric Railroad have passed both branches of the Vermont Legislature and received the Governor's signature. Some preliminary steps toward building the Bennington and Woodford line will probably be undertaken this winter. The proposed Bennington electric railway is nine miles long and of light grades, and will connect with the Hoosick Electric Railway at Walloomac via North Bennington. It is confidently believed that the road will be built. Jos. A. Powers, of Lansingburgh, N. Y., can probably give information.

PHILADELPHIA, PA.—All doubt of a trolley line around and through Fairmount Park was settled when the Park Commissioners adopted the amended route. So soon as the Committee on Plans and Improvements approve the plans the work of construction will begin, and it is expected to be in operation by July 1, of next year. The road is to be 6 miles in length, and will include a stone and steel bridge, 1,300 feet long, which will cross the Schuylkill River opposite Strawberry Mansion, and which Wm. Wharton, Jr., to whom the license for the road was granted, estimates will cost $400,000. The total cost, including bridge and equipment, will be about $1,000,000.

Miscellaneous Notes

AN INVENTOR'S SUIT.—An inventor of Pittsburg named James S. Zerbe has sued the Westinghouse Electric and Manufacturing Company for $400,000 for alleged infringement of a "sliding bar incandescent lamp socket" patent.

THE MANUFACTURERS ASSOCIATION of Cincinnati, Ohio, in order to promote the prosperity of the manufacturing interests of the entire country, and appreciating the importance of concerted action, has sent to the officers of all commercial exchanges in the United States supposed to take cognizance of the interests of manufacturers, a circular inviting representation at a conference of manufacturers, which will be held in the city of Cincinnati, on the 22d day of January, 1895, for the purpose of a general interchange of views looking to the formation of a National Association of Manufactures, which shall embrace among its purposes: 1st. The advocacy of carefully considered legislation, to encourage industries of all classes throughout the country. 2nd. The discussion of ways and means whereby trade relations between the United States and foreign countries may be developed and extended. 3rd. The establishment in South American capitals and other desirable points of permanent expositions for the display of American products. 4th. Such other topics as may be agreed upon by the Convention. It is desired that this Convention shall be non-political, non-partisan and non-sectional. The invitation is without limit as to number of attendants, and is cordially extended not only to accredited delegates from organized exchanges, representing manufacturing interests, but to any individual manufacturer who may have the promotion of the general good by organized effort at heart.

Trade and Industrial Notes.

THE GILLILAND TELEPHONE COMPANY 186 Fifth Avenue, Chicago, is meeting with much success in the installation of its magneto-telephones and

switchboards. It has received orders for exchanges of from 50 to 500 instruments.

T. J. MURPHY & CO., marble and slate manufacturers for electric purposes, 136 Liberty street, New York, have been very busy enlarging his factory He reports business very lively, and is bringing out some new designs of switchboards, etc.

MR. L. W. SWEET, 34 Maiden Lane, New York, proprietor of the engine stop apparatus, is much elated over the success he is having with his device. He is putting in as many as he can turn out, and receiving some very flattering testimonials from first-class people.

THE CENTRAL ELECTRIC COMPANY, 173 Adams street, Chicago, has issued a supplement to its general catalogue, which carries the folios from 527 to 634. The addition comprises the latest specialties and improvements, being up to date in every department.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York, has issued a second edition of its very complete catalogue of telephones. Many different telephone outfits are illustrated and described, with remarks as to the special use of each one.

RUMSEY & COMPANY, Seneca Falls, N. Y., has issued the 49th edition of their elaborate catalogue of pumps and hydraulic appparatus, containing no less than 172 large pages of descriptions and illustrations of hand power pumps, and hydraulic and pumping machnery for all purposes.

THE MIANUS ELECTRIC COMPANY, Mianus, Conn., has issued an attractive catalogue of its interior and exterior loud speaking telephones. This company manufactures a large number of styles of telephones and transmitters for long and short distance work, as well as magnets and extension bells, insulators, hooks, magnets, telephone switchboards, etc.

A. T. HOWARD & CO., 149 Church street, New York, in a neat 8-page pamphlet, describes and points out the merits of the various grades of B. & S. compound which they manufacture. It is claimed that this compound, of which one of the constituents is bi-sulphide of carbon, has more points of excellence than any other, odorous or odorless, on the market.

MR. JAMES W. GODFREY has resigned his position of general manager of the New York Insulated Wire Company, 15 Cortlandt street, New York. Mr. Godfrey has been with the company since 1887, and is one of the most popular and well known gentlemen in the electrical trade. Mr. F. W. Harrington, head of the sales department, is acting general manager for the present.

THE LUNKENHEIMER COMPANY, 11 East Eighth street, Cincinnati, has its 1895 catalogue already in the field. It contains 108 large, handsomely printed pages and numerous illustrations, all of which are unusually well executed—the company adhering to good wood cuts for the illustrations of its apparatus, as it does to standards of material and methods in their construction.

DAVID CHALMERS, New York agent of the Holtzer-Cabot Electric Company, 114 Liberty street, has had a complete electric plant installed in his office, and takes much pleasure in showing it to the visitors. Mr. Chalmers reports doing a large dynamo and motor business, and also in general electric supplies, and states that the Holtzer-Cabot Company (Boston) is running day and night.

CHARLES A. STRELINGER & CO., Detroit, Mich., in a catalogue of several hundred compactly printed pages containing more than 1,300 illustrations, gives descriptions and prices of every imaginable kind of hardware and mechanical supplies, steam goods, iron-working machinery, etc. Each article is accompanied by an intelligently written note referring to its particular use, merit, etc.

THE NUTTING ELECTRIC COMPANY, Chicago, has received many compliments on the efficient manner in which it has illuminated the recently completed tunnel under the Chicago River. The tunnel is 1,514 feet long and 30 feet wide—the largest single span tunnel in the world—and is illuminated by fifty 2,000-cp Nutting arc lamps, supplied from a constant potential circuit of 110 volt pressure.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn. has just been awarded, through its New York contractors, Messrs. H. B. Cobo & Co., the contract for three 100-kw direct connected generators of its new type, for the lighting plant of the new Congressional Library Building at Washington, D. C. Very extensive tests of this new apparatus had been made by government experts at the Manchester factory.

DEAN BROTHERS' STEAM PUMP WORKS, Indianapolis, Ind., are well represented by a catalogue of 134 pages, upon which apparently no expense has been spared. The design of the covers would grace a literary volume, and the quality of paper equals that of an art publication. Scores of forms of the Dean pump are illustrated and described, and at the end of the pamphlet some interesting "Hints on Hydraulics" and useful tables are given.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that it is beginning its fourth business year by making some special inducements in price on the Packard transformer, which has made a great reputation for itself during the last few years for regulation and efficiency, and that it has made a big point on carrying a very large and complete transformer stock in Chicago, enabling it to make immediate shipment from that point, and thus save customers long delays in transit.

THOS. BARRACLOUGH, 20 Bucklersburg, London, England, sends us a large catalogue containing illustrations and descriptions of numerous machines used in the process of covering electric wires and cables with India rubber, gutta percha, silk, cotton, hemp, jute, tape, etc., and for stranding, core serving, sheathing, taping, wiring and compounding machinery. The machinery made by this firm seems to be absolutely inclusive of the processes relating to the art of making every kind of insulated wire and cables.

THE AUTOMATIC ELECTRICAL SPECIALTY COMPANY, of 136 Liberty street, New York, is now the New York agent for the American glazed insulating tubes and insulators. Mr. Auerbacher, of the Automatic Electrical Specialty Company, reports having made some fine sales of these insulating goods already, and is confident of an increased sale, as the tubes and insulators are claimed to be superior to porcelain. The company has opened a salesroom and office at 31 Clinton street, Newark, N. J., where a nice line of electrical supplies of every description will be kept constantly on hand Mr. John C. Ball, formerly in the employ of The E. S. Greeley & Co., will have charge of this office.

THE INTERIOR CONDUIT AND INSULATION COMPANY calls our attention to an unfortunate typographical error in a note printed in this column last week. In referring to the very important amendment made by the New York Board of Fire Underwriters to its rules, we wrote "it has amended Rule 22 so as to permit twin conductors to be used in a complete, fully-insulated, continuous iron conduit," but as printed "prevent" was substituted for the word "permit," thus making the statement convey a meaning exactly the reverse of that intended. As the result announced is one of great importance, and only brought about after considerable effort, we regret that the typographical error should have occurred in particular connection.

THE GENERAL ELECTRIC COMPANY, on account of the increase in its electrical business, has added an extension to its already extensive facilities at Schenectady, and two large buildings are now being constructed there—a storehouse and standardizing laboratory. The storehouse is 353 feet long and 52 feet wide. The fundations are already laid and the superstructure is rising rapidly This will relieve the smaller storehouses now found entirely inadequate. The other building will be used as a laboratory for standardizing. It will be erected on the very outskirts of the tract of land owned by the company at Schenectady, in order that it may be as far away as possible from the disturbing influences of moving iron and heavy electric currents in and around the many buildings of the plant proper. This laboratory will contain all the standard instruments of the company, and with these the many working instruments in use throughout the factories for testing purposes will be compared each day.

WARREN WEBSTER & CO., Camden, N. J., specialists in examining steam plants where increased economy in fuel is desired, by utilizing the wasted exhaust steam, report considerable activity in their business, owing to the better appreciation of their manufactures in comparison with standard apparatus for similar purposes. Among the recent orders for the Webster vacuum feed water heater and purifier to be used in connection with electrical plants, they mention the following: Johnstown Electric Light Company, Johnstown, Pa., 800-hp; Warren Electric Light Company, Warren, Pa., 400-hp; Plattville Electric Light Company, Plattville, Wis., 200-hp; Jerseyville Electric Light, Gas and Power Company, Jerseyville, Ill., 350-hp; Bridgeport Electric Light and Power Company, Bridgeport, O., 250-hp; Card Electric Company, Mansfield, O., 150-hp; Worcester Electric Light Company, Worcester, Mass., 150-hp; The Falkenau Engineering Company, Philadelphia, Pa., 250-hp. In a number of the above contracts other equipments of standard makes of feed water heaters were removed. Numerous orders were also received for the Webster separators and the Williames vacuum system of steam heating.

Business Notices

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 11, 1894.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

530,041. APPARATUS FOR CONTROLLING ELECTRIC ELEVATORS; N. O. Loindstrom, Union Course, and O. P. Cummings, Brooklyn, N. Y. Application filed Sept. 20, 1894. This comprises an auxiliary motor having a non-commutated armature circuit, the polar axis of the armature lying transverse to the field of force, a controlling switch on the car for reversing the armature torque, and reversing switches in the main motor circuit attached by the auxiliary motor.

530,543. CONDUIT ELECTRIC RAILWAY; D. Mason, Schenectady, N. Y. Application filed June 8, 1893. This comprises a tubular current main, an electric generator connected thereto, and means for heating and forcing liquids, vapors or gases through it.

530,575. TELEPHONE TRANSMITTER; A. F. Boardman, Somerville, Mass. Application filed Aug. 8, 1894. This comprises a support having an annular

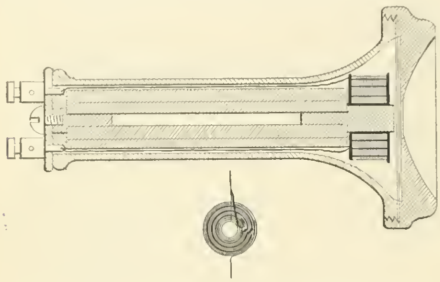
ring, and an offset, a recess in the ring under the offset, a diaphragm supported on the ring, and electrodes mounted on the offset.

530,578. ELECTRIC ELEVATOR CONTROLLER: L. S. Buffington, Minneapolis, and W. C. Jones, Chicago, Ill. Application filed Feb. 23, 1894. The combination with a laterally sliding elevator door, of means for opening the same through the agency of the weight of the door.

530,597. ALTERNATING CURRENT TRANSFORMER: A. W. Meston, St. Louis, Mo. Application filed Jan. 23, 1893. The combination with the inclosing case, of a removable mount for the coils.

530,498. INSULATOR FOR ELECTRIC OVERHEAD CONSTRUCTION; H. P. Ball, Bridgeport, Conn. Application filed June 28, 1894. A strain insulator having a flanged part in conoidal form with an elliptical base, an eye bolt with an engaging part to be inserted in the flange, and insulating material between the parts.

530,507. CONTROLLER FOR ELECTRIC LOCOMOTIVES; J. W. Darley, Jr. Application filed Nov. 16, 1893. This comprises a commutating cylinder, a



No. 530,516.—Suppression of Self-Inductance.

reversing cylinder, and mechanism adapted to permit the starting of the commutating cylinder only when the reversing cylinder is in a running position.

530,516. SUPPRESSION OF SELF-INDUCTIVE OBSTRUCTION IN ELECTRO-MAGNETS; S. D. Field, Stockbridge, Mass. Application filed July 24, 1894 This comprises an electro-magnet, an associated incomplete, electro-static shunt or inductive circuit, connected with one of its terminals, and having branches or extensions interposed between the several layers of its convolutions.

530,522. GALVANIC RING; D. Hattenback, Sioux City, Ia. Application filed Sept. 4, 1894. A metallic ring in two parts soldered together, the metals in each part forming positive and negative electrodes.

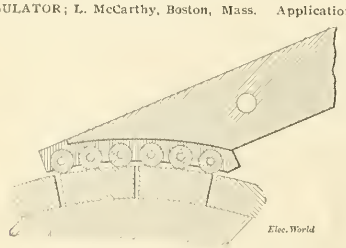
530,619. ELECTRIC MOTOR PROPELLED ELEVATOR; F. E. Herdman, Indianapolis, Ind. Application filed Jan. 31, 1893. This comprises traveling sheaves, cable wound around same, a pivoted lever to which the cable is connected, a spring acting upon the lever, a rod connected to the lever and a connection between the rod and the elevator power regulating mechanism.

530,651. RAIL BOND OR CONNECTOR; C. J. Reed, Philadelphia, Pa. Application filed Sept. 20, 1894. This consists of two separate parts screw-threaded into the ends of the rails and then twisted together, and afterward united by solder.

530,674. TROLLEY WIRE AND SUPPORT THEREFOR; H. H. Ashley, Springfield, Mass. Application filed Aug. 25, 1894. This consists of opposing cheek members with downwardly and inwardly inclined slots, end inclines, central uniting web, and webs at and uniting the upper portions of the cheek members.

530 688. CONDUIT RAILWAY TROLLEY; J. C. Hawley and W. J. Black, Dunnescon, Pa. Application filed March 22, 1894. The combination with a depending standard of a reversible trolley-carrying bracket having a vertically moving spring actuated member.

530,706. INSULATOR; L. McCarthy, Boston, Mass. Application filed Sept.



No. 530,717. Dynamo Brush.

18, 1894. This comprises a case with downwardly projecting skirt with perforations therein, and a mass of insulating material applied to the interior, exterior and edge of the skirt and passing through the perforations.

530,717. BRUSH FOR DYNAMO ELECTRIC MACHINES; E. T. Platt, Chicago, Ill. Application filed June 11, 1894. This comprises a commutator brush provided with a flexible body portion and a series of rolls arranged on an arc of a circle to contact at least two segments of the commutator.

530,727. RHEOSTAT. T. W. Shelton, St. Louis, Mo. Application filed Aug. 20, 1894. This comprises pairs of disks of fire clay bolted together, the disks having embedded therein convolute conductors, and conductors from the bolts to the edges of the disks.

530,748. SYSTEM OF TRANSMITTING AND DISTRIBUTING ELECTRICAL ENERGY; C. C. Chesney, Pittsfield, Mass. Application filed Aug. 19, 1894. This consists in generating three phase currents of low frequency and high tension, operating these by a motor, driving by the motor a two-phase generator adapted to yield currents of high frequency and distributing such currents to translating devices.

530,762. ELECTRICAL BLOCK SIGNAL APPARATUS; U. J. Fry, Milwaukee, Wis., and M. Basford, Oak Park, Ill. Application filed July 5, 1893. This comprises a main circuit connecting two stations, one provided with a signal and a polarized controlling magnet, and the other with a pole changing switch; a circuit breaker arranged to be opened by the operation of the switch, and a train circuit arranged to close the first circuit.

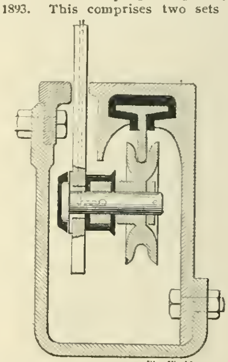
530,763. BLOCK SIGNAL APPARATUS; U. J. Fry, Milwaukee, Wis., and G. M. Basford, Oak Park, Ill. Application filed Sept. 17, 1894. This comprises main line and stations, signals, an electro-magnetic signal locking device and means of releasing the locking device of a distant station, a circuit breaker, a magnet controlling the circuit breaker, in a local circuit provided with two circuit breakers controlled by separate train circuits.

530,764. PRIMARY BATTERY; G. H. Gardner, Boston, Mass. Application filed March 12, 1894. This comprises an annular metallic contact plate moulded into the material of which the cell is composed, and adapted to form a metallic lining for that part of the cell that lies between the porous cup and the walls.

530,773. ELECTRIC MOTOR; F. E. Herdman, Winnetka, Ill. Application filed July 25, 1894. This comprises a translating device, resistances in the circuit, a controlling arm for the resistances, a device adapted to retard the controlling arm, and mechanism controlled by the translating device current to control the said retarding device.

530,798. RAILWAY SIGNAL; J. V. Richardson, Farmville, Va. Application filed March 30, 1894. This comprises a parallel line of conductors arranged in blocks, contact devices carried by the locomotive, and a signal in circuit with the conductors.

530,804. BATTERY SWITCH; H. K. Spangenberg, Leipsic, Germany. Application filed July 24, 1893. This comprises two sets of cells, a switchboard



No. 530,828.—Conduit Railway Trolley.

for regulating the number of cells in use, and a distributing board provided with means for cutting out one set of cells and for coupling the two sets of cells in series or multiple arc.

530,808. FIRE ALARM HUT; Montreal, Canada. Application filed Sept. 17, 1894. The combination of the door, door closing lever, a spring attached to the lever and a blade alongside the bottom edge of the door and having the lever passing therethrough.

530,828. CONDUIT-RAILWAY TROLLEY; W. E. Delabarre, F. McDonald Frazer, and H. A. Carrick, New York, N. Y. Application filed Jan. 26, 1894. This comprises a transmitting arm projecting through the slot of a conduit, a trolley connected to the arm, and a covering of insulating material secured to the arm, the covering being provided at its ends with bevels facing in the opposite direction from that of the trolley.

530,838. INCANDESCENT LAMP; J. R. Grove, New York, N. Y. Application filed May 26, 1893. The combination of a bulb, indepedent section of cast material closing the neck thereof and having an internal ridge for engagement with the socket.

530,847. PROCESS OF MANUFACTURING PLATES FOR SECONDARY BATTERIES; H. F. Kirkepatrick-Picard and H. Thame, London, England. Application filed Jan. 13, 1894. This consists in firing the plates admixed with oxide and sulphide of lead, the adaptation thereto when hard and cold, of semi-vulcanized India-rubber, in a plastic condition, to embrace in a solid mass without joints, the edges of the plate; the adaptation, similarly, of separate pieces to the surface of the plates, and a vulcanization of the frame and separators in situ on the plate by heat.

530,867. PRIMARY BATTERY; W. Walker, Jr., Birmingham, and F. R. Wilkins, Handsworth, Eng. Application filed June 4, 1894. A battery having a negative element of carbon forming part of the jaw containing the exciting solution, with which one surface of the carbon is in contact while the other is exposed to the atmosphere, and a saucer containing the jar and provided with a discharge.

530,882. ARC LIGHT HANGER BOARD; D. J. Cartwright, Boston, Mass. Application filed June 26, 1894. A board constructed in sections having hangers respectively attached thereto and provided with means for securing the sections at different distances apart.

530,895. INCANDESCENT ELECTRIC LAMP; E. Kaye, Monaca, Pa. Application filed Feb. 4, 1893. A lamp with a threaded neck, in combination with a removable plug and cap threaded to screw on to the neck and threaded exteriorly to screw into a lamp socket.

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CONTENTS.

ELECTRICAL POTENTIAL AND ENERGY.

In another column will be found an interesting letter from Prof. Waddell in reply to a criticism on a recent article from his pen by Mr. A. W. K. Peirce. The mechanical analogy to which the criticism refers is an instructive one, if, of course, it correctly represents the facts. The remarks of Mr. Peirce are perfectly just, as stated, but according to Prof. Waddell they do not apply to the case in point. As an illustration he takes the case of a conductor moving across a field of varying intensity; on account of the different rates of cutting lines of force, the potential at different points in the wire will not be the same, and, therefore, a current will be set up even if the conductor is, for example, a straight piece of wire. Though this point has often been discussed before, it is an interesting one and we shall be pleased to hear from others on it.

CONSUMPTION OF ARC CARBONS.

In another column Mr. Alfred H. Bucherer discusses the explanation recently advanced by Drs. Bedell and Crehore in regard to the cause of unequal consumption of the two carbons of an alternating current lamp. Mr. Bucherer first explains the higher temperature of the positive carbon of a continuous current arc as due to an electro-chemical action similar to that of the Peltier effect. He believes also that the action between the poles of arc carbons is analagous with that between the electrodes of a galvanic cell, there being in both cases a transfer by ions or atoms. I twould seem that the higher temperature of the crater of a continuous current arc can be suexplained by reference to the lesser loss of heat from it by radiation on account of its position. In any event, its temperature with a given carbon in a constant, being that of the temperature of carbon vaporization, and it appears to be merely a question of radiation why the positive carbon has a larger area at this temperature than the negative one. Even if the negative carbon were cooled by the action referred to, and the positive carbon further heated, their temperatures would depend upon a relation between the supply of heat and the radiation. As the maximum temperature is fixed, conditions may be imagined where the temperatures would be the same regardless of a greater supply of heat to the negative carbon. It, therefore, seems not to be necessary to explain the difference in temperature of the carbons by any other action than that of radiation.

SUBWAYS FOR ELECTRICAL CONDUCTORS.

The suggestion of Mr. Alfred R. Ledoux, reprinted elsewhere from the *Evening Post* that provision be made for electrical conductors in the underground structure of the New York City rapid transit railways is an excellent one. In some of the plans of underground construction proposed, this could very conveniently be done at a moderate expense, and even if the expense were considerable it would nevertheless be justifiable in view of the present condition of affairs in respect to the control of the electrical subways now installed under the streets of New York. The subway system in this city was unblushingly devised in the interest of corrupt politicians and its administration throughout has been little short of a scandal. The recent Berliner patent decision will again direct attention to one of its abuses, since the control which the Metropolitan Telephone Company has been permitted to acquire in the subways, in effect renders permanent a monopoly that otherwise would have been brought within the field of competition by the expiration of the life of the telephone patents. With the control that this company now has over the subways of New York City, the recent annulment of the Berliner patent was really a matter of minor moment, for how can there be competition, even with every detail in the art of telephony free of patents, if, as is thought by many well informed people, the local telephone company has, through the devious

subway laws, so arranged matters that its competitors cannot install under commercial conditions, the necessary lines? It remains to be demonstrated, however, whether this control is as absolute as is generally supposed, and a prospective competitor would confer a favor on the public and achieve a popularity that, in the event of success, would have a commercial value, by testing the matter in the courts or soliciting the intervention of the legislative power. The municipality is supposed to have the right to take over these subways at some future time, and no time is more propitious than the present to determine if the right is an absolute one, and, if so, to exercise it without delay. In any event advantage should be taken of the building of the rapid transit road to provide for a more comprehensive system of installing electrical conductors than the present one.

THE TELEPHONE SITUATION.

We print elsewhere a budget of matter bearing on the telephone situation which enables it to be viewed from several different standpoints. As will be seen by reference to the opinion of Judge Carpenter, it was decided that the Berliner patent of 1891 comes under the recent decision of the Supreme Court to the effect that a patent is invalid when its subject matter has been disclosed in a previous patent, and which has also claims, though differing in breadth, pertaining to the same features. In the present instance the Court maintained that both the function and the device for effecting the function, are identical in the 1880 and 1891 Berliner patents, and the latter is therefore void. The importance of this point is that if the case comes upon appeal there is offered for consideration, besides the issue of unlawful delay, a point in regard to which the view that will be taken is not uncertain. Some misconception seems to exist in regard to the bearing of the Bate Refrigerator case on the situation, the newspaper comments in connection with the Berliner decision in particular being much at fault in this respect. It is true that a reversal of the present interpretation of the famous statute, 4,887, would revive the Blake and Edison telephone patents, but it is none the less true that these patents are now dead and the inventions to which they refer are public property, free to all. Owing to the circumstances, there seems to be no probability in case these patents are thus revived, that the court would order any accounting of profits. As we have stated before in these columns, it is generally thought by those competent to judge, that the Bate Refrigerator case was carried to the Supreme Court as a forlorn hope, and that the probability of a reversal through it of the present interpretation of section 4,887 of the revised statutes, is exceedingly remote. Assuming, however, that the law involved is reversed, the patents thus revived would not have the presumption of validity in their favor that existed in their favor formerly on account of the principle above referred to, recently laid down by the Supreme Court. The patents would have to be judged by this new criterion, with a probability that neither the Edison nor Blake would stand the test. By reference to the detailed examination of the situation, in another column, it will be seen that at present all forms of telephone receivers and transmitters are free, and on January 15, the valuable patent on the use of the induction coil with the transmitter will expire. As a consequence, private lines may be installed and operated under the most advantageous circumstances. The situation as to large exchange stations, however, is still much involved, and owing to the multiplicity of patents concerned and the scant knowledge on the subject of the requirements of exchanges outside of the Bell Companies, it will be some time before it can be cleared up. It now seems that there would be much difficulty in economically operating any exchange of considerable size without the aid of switchboard and other devices covered by Bell patents. When, however, the difficulties to be overcome are clearly defined and understood, the matter will come within the province of the inventor, and the conditions would have to be singular indeed if some method of meeting them could not be eventually be devised. But if this should this be done, it does not follow that competition with the present local telephone companies would be a simple matter. Their prior occupation of the field, the sagacious preparations, extending over a course of years, that were made with a view to prospective competition, united with a highly trained and efficient force, and exchanges in which the subject of economy of operation has been most exhaustively considered—all of this renders successful competition a question that cannot be taken for granted.

The American Institute of Electrical Engineers.

At the ninety-second meeting of the American Institute of Electrical Engineers, held at 12 West Thirty-first Street, December 19, a paper by Mr. Ludwig Gutmann "On the Production of Rotary Magnetic Fields by a Single Alternating Current" was read by Dr. Pupin.

The principle of the motor described in the paper consists in the division of a closed circuit armature winding into sub-circuits, greater in number than the number of motor poles, that is, in the two-pole motor, the closed armature winding may be connected at three points 120° a part—the connecting wire leading from 0° to a point of the armature winding 120° away, then from 120° to 240° and finally from 240° to 0° again. Each of the sub-circuits thus consists of one-third of the armature winding and a wire joining the extremities of this third, each of the three connecting points on the armature wire being common to the two adjacent sub-circuits.

The result of this system of connections is that a motor has more than one synchronous speed; the greater the number of sub-circuits, the greater the number of speeds at which the armature can operate. If the armature contains ten closed circuits, and rotates in a two-pole field, it will be able to generate five currents, lagging 72 degrees behind one another in phase, and would have at least five speeds which are synchronous.

Looking at the device from a general standpoint, the author states that this particular armature construction embodies all the weak points of a synchronous and all the strong points of the polyphase motor. The weak points are, first, that the machine will not start from state of rest in the form described, the coils act on one another differentially and have a variable and negative value; they are in magnetic stability when at rest, hence, no rotation can result; second, the device has a small starting torque when rotated, owing to the differential action of the coils, which cause, with a small number of closed circuits, strongly oscillating or jumping poles, until a harmonic speed is reached; third, the device, when in rotation, is not reversible by simply changing circuit connections.

The strong points claimed are, first, that the motor develops polyphased currents in its own windings; second, that therefore it is more difficult to pull it out of step as it has the capacity to stand, what I would term, magnetic slippage.

The device can be made to become self-starting as a series, a shunt or an induction motor in a field of single phase or polyphased alternating currents. Suppose we have two simple continuous current motors with their armatures on the same shaft, and with both armature windings connected electrically by four wires at points of equal distance along the circumference, which number of conductors may be reduced or increased, depending on the number of phase currents desired. Now, if we send an alternating current into one of the series motors, then the armature will start from state of rest and will send current impulses into the second armature, which become the more regular the more the armature has approached synchronous speed, where bi-phase currents will be established therein; these react on the field magnet core of the second motor, and for the purpose of maintaining the armature in this synchronous speed, the commutator of the second motor is applied to rectify the polyphase currents, and the resulting continuous current may be used to energize the magnet of this motor.

Rotary Field Motors.

In an editorial in our last issue under the above caption, by a slip of the pen the word "self-induction" was used instead of "reactance" in referring to Dr. Pupin's discussion of Lieut. Reber's paper. The phrase in question should read "The difference in phase in induction motors is produced by the *reactance*, which is greatest when the armature is at rest."

Gisbert Kapp.

Those who occupy themselves entirely with pure theory and science are often looked upon by the mechanic or constructor, as impractical, and their teachings are, as a rule, beyond the reach of those whose occupation is to produce industrial commodities. On the other hand, the scientist generally leaves the application of his discoveries entirely to the mechanic or constructor, as he too often considers this beneath his dignity. The natural result is that there often exists an unfortunate gap between the two classes of workers. Fortunately, however, there is another class consisting of highly educated engineers who are capable of understanding and appreciating pure science while at the same time they are eminently practical, and it is these who fill the gap between the two, thereby bringing the valuable results obtained by the scientific investigator well within the reach of the mechanic or producer of commodities.

The science and industry of electricity is fortunate in having among its workers a number of men of this class, and one of the most eminent of them is Mr. Gisbert Kapp. His education has been such that he is quite capable of comprehending the researches in pure science, and on the other hand his occupation has been chiefly that of a practical engineer and constructor, thus enabling him to apply in practice the best of existing knowledge. The results which he has accomplished show both a thorough knowledge of the principles, as well as a capability of applying them to the best advantage in practice. He was one of the first to develop a theoretical discussion of the dynamo which was of real practical value to the constructor, and his well known papers, in which he first published it, have become almost classical, and even to-day many of the principles brought out by him at an early date are still in constant use by dynamo designers and constructors. His papers and books on the one hand and his types of dynamos and alternators on the other, show the possession of the qualities as scientific investigator and of the constructing engineer which together make the ideal combination that is the object of modern engineering education, though rarely attained.

GISBERT KAPP.

Mr. Kapp was born at Mauer, near Vienna, in the year 1852, but although an Austrian by birth his principal work in the electrical field was done while in London. He was educated at the Polytechic school in Zurich as a mechanical engineer and devoted himself in the earlier part of his career more especially to marine, hydraulic and steam engineering. He was for five years chief draughtsman and designer to Messrs. Gwynne & Company, of London, and during that time he designed the machinery for a large number of pumping stations for drainage works in Holland and for docks in England and the Colonies. This work, curiously enough, was also intimately connected with the gas interest, since the firm of Gwynne & Company was largely employed in the manufacture and creation of direct driven gas exhausters, in connection with which he introduced several improvements.

After leaving Messrs. Gwynne & Company, Mr. Kapp travelled for two years on the Continent and in North Africa on behalf of the agricultural implement firm of Hirnsby & Sons, Ltd., in order to introduce their machinery and establish agencies, but this field of commercial activity did not satisfy his mechanical taste and when in 1882 the electric lighting industry began to take root in England he accepted an appointment as manager at the works of Messrs. Crompton & Company in Chelmesford. One of the first results of this appointment was his invention of compound winding and although it was subsequently shown that the same invention had been made by Varley some years previous, the principle of compounding as carried out practically by Kapp secured something akin to a monopoly to the Chelmesford firm, which lasted until other firms had succeeded by experiment in arriving at the same result.

In the following year Mr. Kapp invented a class of electrical measuring instruments in which permanency of calibration was obtained by the use of over saturated electromagnets. These instruments were known under the name of current or potential indicators and were widely used at that time. They had, however, the drawback of being influenced by external magnetic fields and were long ago superceded by others.

In the year 1885 Mr. Kapp severed his connection with Messrs. Crompton & Company and established himself as a consulting engineer in London. About the same time he developed his well known theory of the dynamo which appeared in the form of papers read before the Institution of Civil Engineers and the Institution of Electrical Engineers, and was one of the first, if not the first, that was of any real value. This theory, and the practical part of the subject, formed the subject of his well known book on "The Electric Transformation of Energy," which appeared in 1886 and has been translated into French and German. A fourth edition of this book appeared in September of the present year. In 1886 Mr. Kapp accepted an appointment as London editor of the journal "*Industries*," which was started at that time, and he occupied the editorial chair for three years until his growing practice as a consulting engineer employed his time to such an extent as to compel him to give up journalistic work.

Mr. Kapp was an early advocate of the advantages of alternating currents for central station work, and he devoted considerable attention to the scientific construction of alternators, transformers and accessory apparatus. The alternator designed by him and known under his name was taken up first by the Oerlikon Electrical Engineering Works in Switzerland and then also by Messrs. Johnson & Phillips in England, and very many of these machines are still in use in Europe.

Last year Mr. Kapp brought out a new type of alternator in which the armature winding is stationary and the coils are so arranged as to be capable of being quickly removed and replaced in case of damage. This type of machine has also been taken up by the two firms above mentioned.

Although Mr. Kapp made many friends in England and had there a very extensive practice as consulting engineer, he has recently left that country and settled in Germany. The cause of this step was the health of his wife, who suffered on account of the English climate. As the physician prescribed for her a change to the more bracing climate of the Continent, Mr. Kapp accepted an offer made him by the Verband Deutscher Elektrotechniker to become its general secretary, and take the editorship of the *Elektro-technische Zeitschirft* with headquarters at Berlin, which position he now holds.

Mr. Kapp's charming personal qualities compel the admiration and respect of all who meet him. His modest, unassuming and cordial manner, combined with his high standing as an engineer, have made him many friends and admirers, as was shown by the universal regret expressed by his colleagues when he left London some months ago and by the testimonial tendered him on that occasion.

Mr. Kapp is a member of the Institution of Electrical Engineers and of the Institution of Civil Engineers, to both of which societies he has presented a number of very valuable papers. He has also been a frequent contributor to the English technical press and has written various works on dynamo electric apparatus, most of which have a world-wide reputation. Recently he has been admitted as a lecturer at the Polytechnic Institute in Berlin, where the lectures on the electromagnetic apparatus, which he is now giving, are highly appreciated.

Judge Carpenter's Opinion in the Berliner Case.

In last week's issue we referred editorially to the important decision of the United States Circuit Court for the District of Massachusetts, in the suit of the United States vs. the American Bell Telephone Company, for the repeal of the Berliner patent of November 17, 1891. In Judge Carpenter's opinion the first point taken up is the identity of the functions of the device described in the patent in suit with those shown in the Berliner patent of November 2, 1880. After discussing the facts at issue Judge Carpenter conclude, that since one of the functions shown in the patent of 1880, namely, the function of transmitting articulate speech, is identical with the sole object or function covered by the patent of 1891, and since the device for effecting the transmission is identical in both patents, the patent in suit is void under the principle laid down by the United States Supreme Court in the case of the Miller vs. Eagle Manufacturing Company, commented upon in THE ELECTRICAL WORLD of February 17, 1894.

The other point involved was that the issue of the patent in suit was unlawfully delayed through the fault of the respondents. The Court relates that the application for the patent was filed June 4, 1877, and the patent was issued November 17, 1891. The patent to Bell expired in March, 1893. The device covered by the patent in suit had been in public use by the respondent corporation since the year 1878. The respondent corporation was of ample means to prosecute the application. The result of any delay which might take place in the issue of the Berliner patent would evidently be to continue so much longer the practical monopoly of the art of electrical transmission of articulate speech. Under these circumstances, the court thinks it clear that the duty of the respon ent corporation was to use the greatest degree of diligence in prosecuting the application to an early issue. There should have been, at least, as great diligence as their own interests would have called for, had their business been unprotected by patent rights.

In examining the question of diligence the court finds that up to June 9, 1882, there is no allegation of delay in prosecuting the application, but from that date to 1888 the issue of the patent was unwarrantably delayed on the plea of expected interference, and there was set on foot a so-called "general understanding" on the part of the patent office examiner and the respective counsel for the Bell Company and for Drawbaugh, with whose application an interference was unwarrantably anticipated; in acquiescing to this understanding the court holds that the Bell Company failed to do its duty and committed a wrong against the public. The plain duty of the Bell Company, it states, was to insist on its right to a patent at once, leaving the question which was pending in the courts to be settled whenever a final decision should be reached, and leaving the decision of that case to have whatever effect it lawfully might on the validity of the patent.

The court is of the opinion that the unwarrantable delay thus caused was intended by the Bell Company, and cannot doubt but that, in matters of this consequence, involving the whole business of a company of so large a capital and engaged in so large affairs, it was fully advised as to the facts and the law; its acts, therefore, were so gross as to forbid any inference except that it dishonestly delayed the issue of the patent, taking advantage for that purpose of the perhaps excusable willingness of the officials of the Patent Office to postpone the decision of a sharply debated question, in which a large public interest was involved, on the chance that a decision of the Supreme Court might supersede the necessity for a decision on their part.

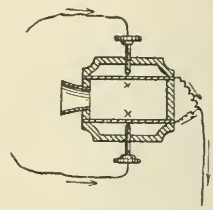
As to the delay after 1888, the court relates that the Drawbaugh claims were decided by the United States Supreme Court to be unfounded in March, 1888, and a proceeding was then set on foot by the Commissioner of Patents to determine if there had been a public use of Drawbaugh's invention for two years before the date of his application; the Berliner application was then again suspended to await the result of this investigation (which was strenuously objected to by Drawbaugh, who took no part in it), and upon a final decision in October, that there had been no such public use, the Berliner patent was ordered to issue.

The court, after examining the facts bearing, is persuaded that the delay, both previous and subsequent to 1888, was intentionally acquiesced in by the Bell Company for the purpose of delaying the issue of the patent. In regards to the proof offered as to the urgent solicitation by the Bell Company for prompt action, the court inti- es that this solicitation was only for effect, and concludes that the real policy was that the application was to be "worked along quietly" although apparently pushed with great energy.

The decision rendered is that the complainant has made out the case and that there should be a decree that the patent in question is void and shall be delivered up to be cancelled.

The Telephone Patent Situation.

Although the Berliner patent claims were of a broad and fundamental nature, and although the decision of Judge Carpenter will be far-reaching in its effects and will open wide the field for telephonic competition, yet it must not be supposed that the practice of the art of telephony has in its entirety been made free by this most popular decision. Aside from its magnificent plant and the present possession of the field, the American Bell Telephone Company still possesses numerous broad and strongly drawn patents controlling many features which have been found most desirable



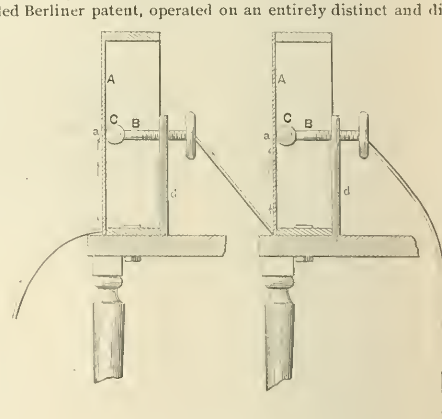
BERLINER—1880.

if not absolutely essential to the operation and very existence o a successful telephone system. Many of these patents have, however, but a short period of future existence.

Briefly, the present patent status appears to be as folows:

The fundamental patent issued to Alexander Graham Bell, covering the art of electrical telephony, expired at its full term early in 1893. One year later the broad patents expired, which controlled the use of the magneto telephone as either a transmitter or a receiver and the field was thrown open to the public for the use of such instruments. The magnetotransmitter, however, utilizing as it does at best only a portion of the energy of the voice for transmission, would never satisfy the demands for a commercial transmitter.

The battery transmitter, claimed broadly and fundamentally in the voided Berliner patent, operated on an entirely distinct and different



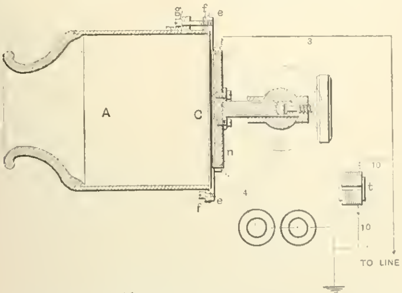
BERLINER—1891.

principle from these magneto instruments. No longer was the voice required to *transmit* its energy out upon the line but only to act as a throttle valve for the energy of transmission, which energy is supplied by a separate source of power, *i. e.*, a battery. Thus, and only thus, did long distance telephony become a reality.

The full effect, however, of the decision of Judge Carpenter in throwing all forms of the present commercial battery transmitters open is dependent upon the present statute law, now contested in the Bate Refrigerator case, being sustained to the public, and the decision does not in any way affect, of course, the firmly woven network of switchboard and detail patents which are controlled by the American Bell Telephone Company, and its ally, the Western Electric Company.

The detail patents granted to Francis Blake and owned by the American Bell Telephone Company, covering many essential but detail features and of the present commercial "Blake" transmitter, have already expired by limitation due to British patents under the now famous section 4,887 of the Revised Statutes. The broad fundamental idea of this transmitter is contained in the patent granted to Thos. A Edison, No. 474,211, filed on July 20, 1877, and issued almost fifteen years later, on May 3, 1892.

In this the claim reads: "In a telegraphic apparatus operated by sound, the combination with the diaphragm of one or more con-

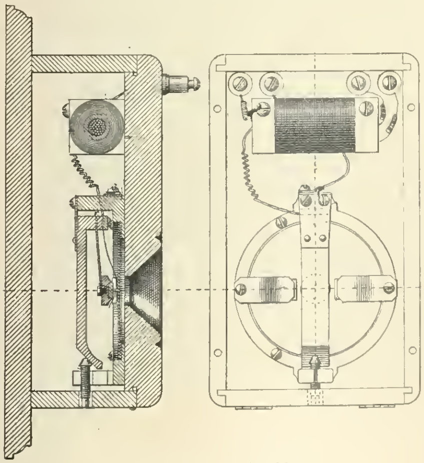


Edison—No. 474,230.

tact points of plumbago or similar inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point or points by the diaphragm, substantially as set forth."

This patent, together with the two sister patents of Edison numbered 474,330 and 474,332, and covering further details of the Blake transmitter, are invalid under the present interpretation of section 4,887 Revised Statutes, as they were issued subsequent to the *expiration* of the British patent No. 2,409, July 30, 1891, for the same inventions. The Blake transmitter, in its essential details, is therefore public property. Should the Supreme Court, however, reverse in the Bate Refrigerator case the present interpretation of this statute, the life of this patent will be revived, but this, in the opinion of many able lawyers, is a very remote contingency.

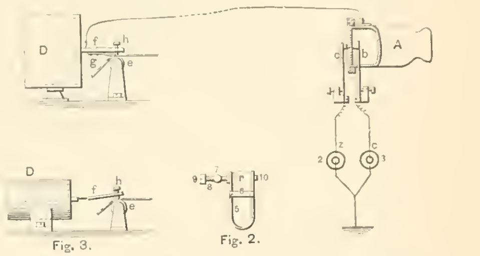
Coming now to the class of transmitters using finely divided carbon or electrically similar substance, and which include that class of transmitters in use by the American Bell Telephone Company for all



Blake—No. 250,128.

"Long Distance" service, we find that the two fundamental American patents numbered 246,512 and 250,250, issued to Henry Hunning, of England, on Aug. 30, 1881 and Nov. 29, 1881, expired by limitation on Sept. 16, 1892, on account of Hunning's previous English patent of Sept. 16, 1878, covering the same inventions.

This date being even previous to the date of the *filing* of the American patent, there is no question raised as to its definite expiration under Section 4,887. But while these patents were fundamental and claimed "as a tension-regulator or means for varying the resistance in a telephone transmitter finely divided conducting material in a loose or free state, substantially is described," yet there are other detail patents belonging to the American Bell Telephone Company which have assisted in the perfecting of the present long-distance transmitter. Thus, although carbon itself is not the exclusive property of the Bell Company for telephonic purposes, yet it possesses a patent granted to Thos. A. Edison, July 9, 1889, numbered 406,567 on "an electrode for telephones composed of a body of granules of carbonized hard coal," which covers that particular grade of carbon which has been found to be excellently adapted tor transmitter purposes. The mechanical structure of the present long distance transmitter is also covered by the patent issued to Anthony G. White, on Nov.

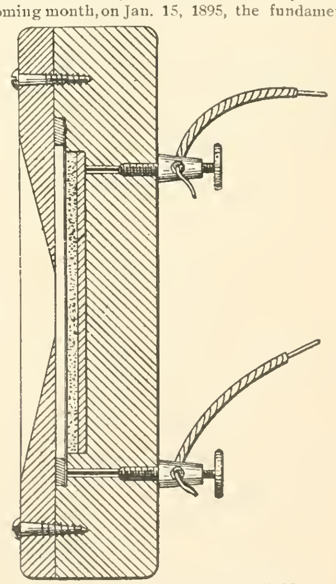


Edison—No. 474,231,

1, 1892 numbered 458,311. But it is apparent that even without the aid of the Supreme Court decision of the Bate Refrigerator case, the production of a commercial long-distance transmitter avoiding all infringements of American Bell Telephone Company's patents and employing finely divided carbon or other conducting substance is dependent only upon a knowledge of the art and the requisite skill in mechanical construction.

But having secured a transmitter and the present magneto receiver, the question of operation arises.

It was early found highly advantageous to use the induction coil in connection with the battery transmitter for telephonic purposes. Within the coming month, on Jan. 15, 1895, the fundamental patent

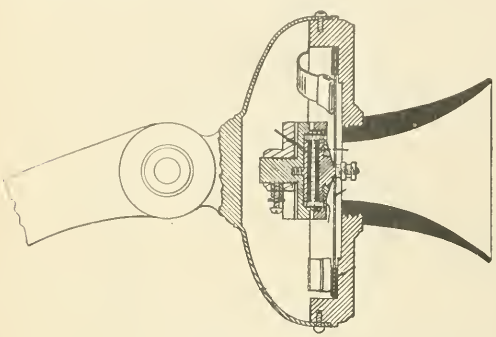


Hunning—Nos. 246,512 and 250,250.

on the use of an induction coil for telephonic purposes will expire. This is the patent issued to Emile Berliner, Jan. 15, 1878, numbered 199,141, and reissued Dec 14, 1880, numbered 9,499.

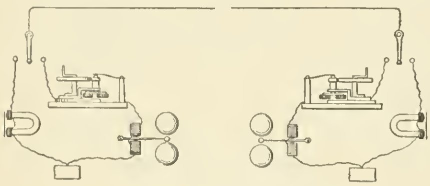
Other combination patents are, however, in force with longer terms before expiration which are of sufficient importance to demand attention. The most important of these are, perhaps, those of Thomas Watson, issued Jan. 9, 1883, numbered 270,522, and April, 16, 1878, numbered 202,495. The former of these two broadly claims the combination of the induction coil with any form of a switch which severs the "call" circuit and "makes" the talking circuit, or the reverse. This patent does not expire until Jan. 9,

1900, and by some writers of very recent date has been considered to be almost an unsurmountable obstacle in the equipment of a subscribers' station by a competitor of the American Bell Telephone Company. But when we consider the fact that for several years such a



WHITE—No. 485,311.

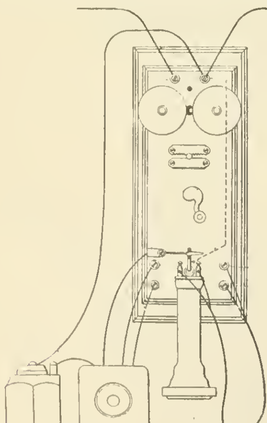
combination and switch have constituted an abandoned method by the American Bell Telephone Company, it is useless to spend any more "sleepless nights" over the subject. The latter patent, however, No. 202,495, claims broadly the use of a signalling apparatus in an independent or branch circuit, arranged and adopted to call



WATSON—No. 202,495.

the attention of the distant operator, and were it not that this patent expires in less than four months, on April 16, 1895, it might cause considerable uneasiness for the would be competitor.

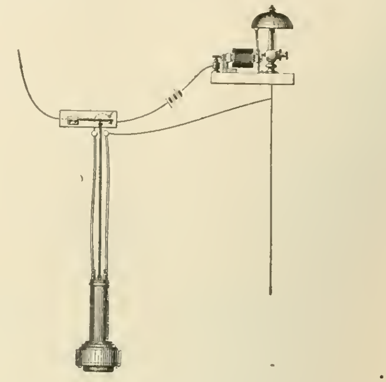
Aside from such combination patents, the receiver switch, or hook itself, has received marked attention from the American Bell and



WATSON—No. 270,522.

from numerous inventors who have assigned patents to it, but a careful examination of these many patents fails to reveal the monopoly of a telephone hook suitable for all commercial purposes, even including the extremely broad claims of the Roosevelt patent, No. 215,837 which will expire on May 27,1896. This, then, narrows the question down to one of switchboards and similar operating devices.

While there appears to be no restraining force to prevent the use of an ordinary plug, connecting boards for switchboard purposes and annunciators for signalling purposes, such as are suitable and advantageous for smaller town and village exchanges, yet the multiple switchboard and its essential combinations, with the necessary busy tests and operators' devices, such as have been found to be highly advantageous to a quick and economical service in the



ROOSEVELT—No. 215,837.

larger exchanges of our cities, are so fully and intricately tied up that their consideration must necessarily pass from the hand of the editor to the hands of the engineer and inventor.

What Is Thought of the Telephone Decision.

There has been no decision since that affecting the validity of the Edison lamp so important to the electrical industries as that handed down last week by Judge Carpenter at Boston annulling the patent for the Berliner transmitter. The following expressions of opinion will therefore be read with interest, coming as they do from men prominently identified with telephone interests, and thus naturally aquainted with the intricacies of the situation:

J. E. Keelyn, president Western Telephone Construction Company, Chicago: "The decision will undoubtedly result in the active installation of telephone exchanges in nearly all of the smaller cities and villages of the United States and the connection of one with the other. It is probable that the larger cities will find difficulty in overcoming the environments of strong existing companies, but cities of 50,000 or less population will undoubtedly be revolutionized in the character of their service and rates for the same in the immediate future. This competition will necessarily force a self-protecting attitude upon the part of the Bell Company's licensees in the cities as stated. The low rates will not admit of paying royalties and dividends to both the Bell Company and licensee companies. This must involve difficulty, probably also violation of contracts and litigation. The prospect for the next year is that the Bell Company will be kept too busy taking care of affairs with its licensees to worry competing companies, and the latter will be kept busy increasing their business."

E. A. Catlin, president The Mason Telephone Company, Richmond, Va.: "The decision in the Berliner case was by no means a surprise to us. Law and justice, if we may separate the two, pointed to such a result. The American people are certainly tired of the heavy taxations put upon them by monopolies, and they demand that where there exists a doubt, it shall be construed in their favor. Two years hence, one will wonder why men of common sense so short a time back could have thought there was any doubt as to the outcome. Certain it is that purchasers of our telephones will no longer have any fears."

Maj. S. W. Groesbeck, president Brown Telephone and Telegraph Company, Chicago: "The effect of the decision will, of course, be to open the field for numberless companies to make and sell the Bell Company's telephone apparatus. With few exceptions these companies will have but an ephemeral existence, but we may look for improvements in the telephone and ability in catering to the public on the part of a few companies, which will insure lower rates to users of all forms of telephones. Regarding the magneto phone, the public esteems it as inferior, and until a much greater advance is made in the efficiency of that instrument there will be but a limited demand for it. In long distance work the Bell Company will easily hold the lead, but in local exchanges it will be compelled very soon to lower its tolls."

J. J. Gorman, manager of the Manhattan Electric Supply Com-

pany, New York: "Thus far we have confined ourselves to the manufacture of magneto telephones, but since the decision we have put the question to our attorneys whether it would be advisable for us to manufacture battery telephones. If they decide affirmatively we will begin the manufacture of battery telephones at once."

F. P. Fish, counsel for the Bell Telephone Company: "As attorney for the defendants in the case, I do not wish to discuss any of the technicalities involved in the recent decision. We have a right to appeal and will do so as soon as the decree is issued. I do not expect a decision from the Circuit Court of Appeals next spring, as some of the papers quoted me as saying, but I think the case will be argued by April."

Park Benjamin, New York: "I have not seen the full text of Judge Carpenter's decision, but so far as I have read the case seems to have been decided more on legal technicalities than on either merit or priority. It is a question of patent law, not of electrical invention. However, I think the decision will lead to developments in patent litigation now unlooked for, as the court's present holding puts an entirely different phase on some of the former decisions in telephone patent cases."

E. S. Wallace, attorney of the Columbia Telephone Manufacturing Company, of New York: "While our legal position was unassailable before the decision of Judge Carpenter, we rejoice that the people are freed from the incubus of a grasping monopoly. Telephones have become a necessity in every household, and the public is entitled to telephone service at fair prices. The people will now have no fear of litigation, and will not be subjected to threats or intimidations. A wide open field is presented and we expect our 'phones' to come into general use. In the other matter of subways and franchises, the Bell people have undoubtedly a hold which cannot be shaken for many years. We can compete with them in the small towns, and by lowering prices in suburban places, the urban population will, after a while, begin to rebel at the higher city rates. The Bell people will then either have to reduce prices or some of their competitors will eventually get the city business. Our exchange system is of our own invention, works automatically, and we consider it superior to any other in use."

U. T. Fackenthall, manager of the Drawbaugh Telephone Company, New York: "This decision puts us in a stronger position than we ever were before in regard to telephone patent rights. We expect to compete with the existing telephone service in both large and small cities, and we shall push our system vigorously. As the telephone, like the telegraph, requires a company with heavy capitalization to fulfill the demands of the public, probably only a few companies will eventually survive in the now open competition, and we expect to be one of them."

T. J. McGuire, manager Phoenix Telephone Company, New York: "We now make only magneto telephones, so the decision will have little weight with us either way."

Barnard & Hoopes, Philadelphia: "We regard the decision simply as a step towards demonstrating the right of the general public to enter into the telephone business, and feel confident that future decisions will be in line with this one."

W. E. Russell, of the Danbury Electrical Works, Danbury, Conn: "We can but acknowledge the justice in the decision of the court in declaring the Berliner patent void. And we feel that competition in the telephone business will now begin in earnest, and that low rental charges must prevail in exchange work."

J. D. Leatherbee, treasurer National Telephone Manufacturing Company, Boston: "This company determined its policy with reference to electrical telephones some time last winter. The Berliner patent subject was thoroughly considered, and we have no reason to regret the decision reached with reference to our policy, which we had no doubt would be upheld and confirmed by the United States Court. We never for one moment thought that such a monopoly could be perpetuated for another term of years, when the fact was taken into consideration that the Bell Company was the sole owner and proprietor of all the inventions in controversy. I will simply add that we believe the decision will be far reaching, and I know you will excuse me from saying anything more on the subject at this time, for we are very much abused every day by customers who think we are doing them great injustice in not shipping telephones more promptly."

American Mutual Telephone Co., New Brunswick, N.J, by Arthur Pomeroy, secretary. "No one who is acquainted with the telephone situation will question that the recent decision strikes a severe blow at battery-phone patents controlled by the Bell Company. At the same time it is also a fact beyond any possible doubt, in our opinion, that the opposition companies introducing systems wherein battery carbon transmitters are used will have many obstacles to overcome in the form of the induction coil, the automatic hook switch, etc., all of which we consider absolutely necessary to give good battery-phone exchange service.

"In view of this fact our company has concluded to make no effort for the present to introduce battery-carbon phone systems.

"We believe, however, that the recent decision against the Bell Company will hasten the time when battery-phones, and all appliances thereto will be open to the public, as many of the patents above referred to have no great length of time to run.

"Like other manufacturers of phones, switch-boards and telephone exchange appliances, we pride ourselves on having the best system in the market, but before blowing our own horn to any extent we are going to show the public what we can do with a magneto system that is absolutely non-infringing.

"Our magnetophone is entirely different from any other form of magneto transmitter ever produced, and if it does not prove to be fifty per cent. better in the transmission of speech and articulation than any magnetophone we have had the pleasure of testing in exchange service, we shall not attempt to build our second exchange.

"Our facilities are such that we can manufacture several forms of battery carbon phones about equal to the Blake transmitter, but we invariably tell customers that we are willing to do so only on the condition that the purchaser shall take the risk of being interfered with by the Bell Company.

"We are frank to state that in our opinion the public is misled on one point with reference to the recent decision, in that the cancelling of the Berliner patent does not leave the long distance battery phone now in use by the Bell Company free, as there are many points not covered by the annulled patent, which we think are absolutely necessary to give battery phone service anything like that which is now furnished by the Bell Company.

"When we have completed our Freehold (N. J.) exchange, which will not be later than January 10, we shall be pleased to give you an opportunity to examine it, and let it speak on its own merits."

The American Bell's "Policy of Silence."

An effort by The Electrical World to secure on behalf of its readers the views of the Bell Company with regard to the recent Berliner decision, did not meet with the success it deserved.

The refusal, however, was so neatly conveyed that we ourselves quite enjoyed the quiet humor of the note in which the indisposition to discuss the matter was so delicately put. In fact, we consider it so excellent that we share the *bon mot* with our readers.

This is the letter (written as a personal communication to a gentleman whose name as representing the American Bell is as well known as the telephone itself) asking for the views:

New York, Dec. 19th, 1894.

Dear Mr. ———

Judge Carpenter does not seem to have followed the example of most of the other Judges, who have decided cases in which the American Bell Company was interested.

I do not know whether this outcome of the suit was what you gentlemen of the American Bell expected, but we should be very glad to have for publication in the issue which (on account of the Christmas holiday) will go to press on Friday, your views or the views, of Mr. ———, or of some one else representing the company, as to the probable effect of the decision.

Mr. T. C. Platt sometimes sends to the newspapers interviews with himself. If we cannot get an opinion over a man's signature, possibly we could get him to interview himself and send us the result.

Of course you appreciate that our only object is to be perfectly fair and impartial in giving the views of a number of men respecting the decision. Most of these will, naturally, be from those whose interests are opposed to that of your company, and that is why we would like something from the American Bell.

Kindly see what you can do for us in the matter and very much oblige.

With kind regards and the Compliments of the Season,

I remain, sincerely yours,

W. J. Johnston.

Here is the reply, received on Friday morning:

Dear Mr. Johnston: In response to your request (for an opinion regarding the Berliner case) it gives me pleasure to cordially reciprocate the personal good wishes contained in your letter. Trusting you will have a pleasant and happy Christmas, I am,

Very truly yours,

———————.

It seems a pity that a man who can write so admirable a letter should have to worry even for a moment over an adverse law decision.

Rope Driving—XIII.

BY J. J. FLATHER.

For the ordinary factory shafting from which power is taken fairly uniformly throughout its length and distributed horizontally to counter or auxilliary shafts, situated on one or both sides of the main shaft, there will be three general cases to be considered, as shown in Figs. 41, 42 and 43, and each of these cases will be

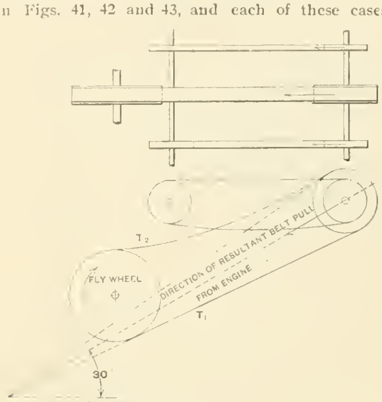


FIG. 41.

modified, depending upon the direction of the belt to and from the main shaft.

For our present purposes it will be sufficient to take that case in which the shaft friction is a maximum for the assumed direction of belt pull corresponding to the arrangement shown in Fig. 41.

The friction will evidently be proportional to the weight of the shaft and the unbalanced belt pull acting on the shaft.

The weight of pulleys, belts and couplings carried by the line shaft will vary from about one and one-half to three times the weight of

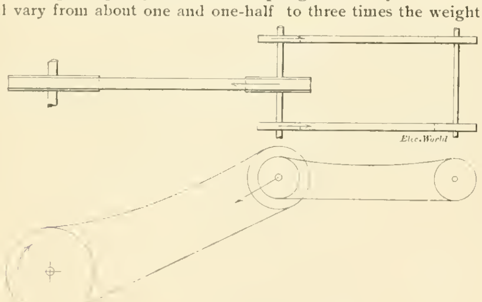


FIG. 42.

shaft, so that the total weight on the bearings will vary from two and one-half to four times the weight of shaft; for head and jack-shafts the total weight will probably vary from three to five times the weight of shaft.

In addition to this weight there is the unbalanced belt pull, which increases the load on the bearings. Although the tension on the tight side of the belt should not ordinarily exceed about twice the tension in the slack side necessary for adhesion, yet it is probable that belts are frequently run with a ratio of tension equal to one to three, and occasionally one to four; on the other hand, it is a very common thing for belts, especially short ones, to be laced so taut that the initial tension is greatly in excess of that required for adhesion, in which case the sum of the tension approaches twice that in the tight side of the belt.*

With ordinary shopworn belting it will be safe to assume that the tension T_2 on the slack side of the belts is one-half the tension T_1 on the tight or driving side, that is, $T_2 = \frac{T_1}{2}$; hence, since $T_1 - T_2 = P$, the driving force, we have $\frac{T_1}{2} = P$, and $HP = \frac{T_1}{2} \times \frac{V}{33000}$.

The velocity of intermediate belting is so variable that any assumption of speed must be regarded as applying to a particular case or representative of a certain type of factory, and cannot be taken as general. In many machine shops the average speed of intermediate belts is not more than 500 feet per minute; in others the average speed is more than twice as great, and in wood-working shops it is still greater.

For our present purpose we shall assume an average speed of 660 feet per minute for belts running from the main shaft to a secondary or counter shaft.

Substituting this value in $HP = \frac{T_1}{2} \times \frac{V}{33000}$ there is obtained $T_1 = \frac{2 \times 33000}{660} HP = 100 \times HP$; but since the horse-power transmitted by the shaft $= \frac{d^3 N}{100}$ we have the tension on the tight side of all the belts $\Sigma T_1 = 100 \times \frac{d^3 N}{100} = d^3 N$, therefore the sum of tensions $\Sigma (T_1 + T_2) = \frac{3}{2} d^3 N$, and the pull per foot of length of shaft $= \frac{3 d^3 N}{2 L}$.

In the present case it will be noted by reference to Fig. 41 that there is an additional pull on the bearings due to the tensions in the belt from fly wheel to main line shaft. If the ratio of tight to slack side tension remains the same as before, and we consider that

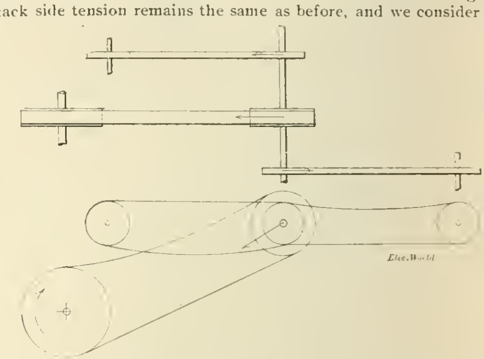


FIG. 43.

the velocity of main belt is four times as great as that of the intermediate belting, the additional belt pull will equal approximately one-fourth of the sum of the belt pulls from the main to the counter shafts or machinery. The resultant of these tensions, combined with the weight of shafting and pulleys, will be the effective load on the bearings.

(To be continued.)

* We have seen shop belts laced so tight that they would barely drive their counter-shafts or machine spindles, and yet by slacking out the lacing or inserting a short piece of belt heavy cuts could be taken where it was almost impossible to run the machine empty with the tight belt.

New York City Subways.

Mr. Albert R. Ledoux, in a letter to the New York *Evening Post*, recommends that provision be made by the Rapid Transit Commission in its plans for the disposal of underground wires.

He says that under the terms of the franchise bestowed upon the Metropolitan Telephone Company (indirectly), by which they construct and receive the rental of electrical subways in this city, the municipality has the right to take over these subways at some future time. Whether the city avails itself of its rights under this particular contract or not, there is no question but that at some period it will come into possession of these subways; the people will demand it.

Mr. Ledoux states that in his first report to the commissioners of electrical subways, he advocated a tunnel system for the disposal of the wires, gas and water pipes, but the expense precluded the adoption of this system. It occurs to him now that in connection with the tunnels of the rapid transit system, at very little increased expense, a compartment for wires could be provided that would care for all the trunk lines up and down the island, carrying also the out of-town lines which diverge up the Hudson River, and along the New Haven, Railways respectively.

A Direct-Connected Arc Light Station.

The first direct-connected arc light station in the United States was started on the night of December 17, at the station of the Mutual Electric Light and Power Company, Chicago. The plant consists of Willans' engines direct-connected to 125-light Brush dynamos running Brush-Adams lamps. This is a commencement which promises to relieve arc lighting of the reproach that it has lagged far behind in the march of electrical progress.

Rapid Transit.

BY C. WELLMAN PARKS

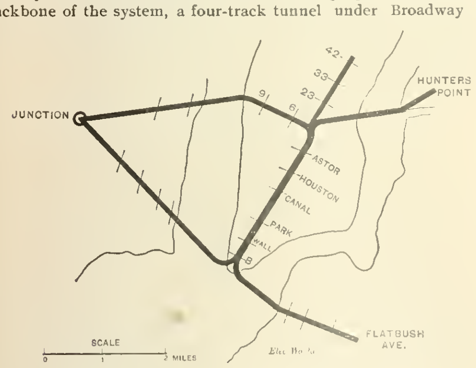
The people of New York having at the last election given favorable majorities to the Rapid Transit and Greater New York propositions, must be understood to want all whose daily business life is spent in New York to be able to live under the same municipal government and to circulate freely between their homes and places of business.

Until now the plans which have been favorably considered by the Rapid Transit Commission have been devised for the almost exclusive benefit of the residents of the upper end of Manhattan Island and the district north of the Harlem River. This is as it should be, but there are other residence quarters which need attention. Residents of New Jersey and Long Island are waiting as patiently as possible for the time when they will be able to reach their business in New York without quite so many transfers as at present. The Brooklyn Bridge and the ferries care for this traffic about as well as they can, but no system can be perfect which requires two transfers. In the case of the Brooklyn Bridge I have never felt quite sure that these transfers are necessary, for it has seemed possible to find some way to run through cars from stations on the Brooklyn roads to the Grand Central Depot and also through Chambers or Reade to Church Street and so to the Battery.

It is proposed to avoid one transfer, so far as New Jersey passengers are concerned, by the erection of a gigantic bridge across the North River. Trains which arrive over this bridge would land their passengers in an immense union station rather too far uptown to accommodate any but the shopping people. The congestion of traffic at a terminal and transfer station located as that one would be could not but result in many serious accidents. While this bridge plan may be perfectly good from that engineering standpoint which ignores cost, it does not seem to be practicable from the broader engineering standpoint which does consider outlay and return. The absurdity of the requirement that piers shall not be erected in the river cannot be discussed at this time.

The proposition to build two bridges to connect the Manhattan and Long Island railroads is much more attractive, but if the project is carried out it will be found to be very costly.

Whatever may be done for the purely urban traffic, the New Jersey and Long Island traffic needs attention, and the following plan is suggested to show what can be done by using tunnels. Nearly all of this traffic originating outside of New York must reach the city below Fourteenth Street. I would propose then, as the backbone of the system, a four-track tunnel under Broadway or a

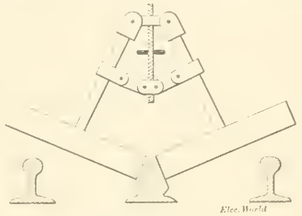


Map of Proposed Routes.

neighboring street, from Union Square to the Battery with stations at Union Square, Astor Place, Houston Street, Canal Street, City Hall, Wall Street, and the Battery. As the four sub-surface tracks of the Rapid Transit Commission's Broadway line will be required for the Manhattan Island traffic, the proposed tunnel would be independent of and much deeper than their subway. At Union Square the main line would be joined by a two-track line from the Grand Central Depot, a two-track tunnel from Hunter's Point, and the Hoboken tunnel through Fourteenth Street. At the Battery the main tunnel would be joined by two-track tunnels from Flatbush Avenue, Brooklyn, and the west side of Jersey City Heights, where a grand junction of all of the New Jersey railroads and the Hoboken and Jersey City tunnels would be made.

As we are no longer confined to the use of coal burning locomotives, clean electric motors can be used to propel the trains, and electricity can be used to operate the pumps and light the tunnel and trains. Ordinary locomotives would not be practicable unless easy grades were secured, either by building the tunnels in the shifting silt which overlies the rock in the bed of the North River, or by building very long approaches to tunnels built in the rock a couple of hundred feet below the surface of the river.

The Van Zile Electric Tractor, which has worked satisfactorily on a trial track, makes it possible to use as heavy a grade as is needed, even five thousand feet to the mile if passengers could keep their seats on such a grade. This tractor is built on the unusual principle of automatically controlled pressure between the driving wheels and the rail instead of the usual principle of pressure con-



Electric Tractor.

trolled by grade. In the former case when more power is required the pressure is increased, in the latter case when climbing grades where more power is required than on a level the pressure is decreased so that less instead of more power is available.

In place of the usual vertical driving wheels the Van Zile electric tractor uses pairs of horizontal or inclined wheels which press upon opposite sides of a third or traction rail. It will be seen that if these wheels can be drawn towards each other by the Van Zile apparatus, a toggle joint or other contrivance, a single pair of drivers can be made to furnish as much traction as a mogul engine on a level track. The pull on an inclined track is as much as on the level, for it is in no way influenced by the grade. If inclined drivers are used the track and switches can be easily built and maintained.

With such motors it will be easy to work trains through the tunnels at a uniform speed over all grades. Traction being independent of the weight of the motors, they can be made as light as is consistent with the rules of good electrical and mechanical construction.

This system of tunnels would enable every road entering New York to land its passengers at stations near their destinations; it would enable New Jersey and Long Island railroads to operate belt lines; it would enable the New York Central and the New York, New Haven, and Hartford Railroads to remove their car sheds to Brooklyn and their round houses to the northern limits of the city; and it would greatly facilitate the transmission of mails by making it possible to load and unload all mail cars at the Post Office.

The whole system could be built and equipped for less than $25,000,000, or about half as much as a single span bridge across the North River will cost.

Its usefulness would exceed that of the Severn, Mersey, Thames, Detroit, and Chicago River Tunnels combined.

London's New Electric Railway.

The latest projected railway in London, which is to connect Waterloo Station, the terminus of the London and South Western Railway with the very heart of the city, is making rapid progress. It is to be entirely underground; indeed, daylight would have difficulty in penetrating to its depth, and electricity will, therefore, be employed as the propelling power. The many disagreeable features of steam in underground traction are emphatically deterrent to the citizens of London, and even the County Council would hardly dare to countenance a duplicate of the present District Railway, which, as all travelers know, is a slightly modified hades about ten to twenty feet below the street level.

Examinations of the plant show that the railroad will start at Waterloo at a depth of thirty-six feet below the level of the South Western Railroad tracks, and will descend in the direction of the River Thames at a gradient of one in sixty. The track will then pass diagonally beneath the river for a distance of some three hundred yards, and will ascend in the direction of the city at a gradient of one in eighty-eight. The tunnel beneath the Thames will be cut at a depth of about twenty-four feet below the river bed, or, in other words, the level of the underground tracks will be about sixty-two feet below the Thames high water mark.

On the Surrey or south side of the river, at Cross Street, where the road will pass underneath the viaduct of the London and South Eastern Railway the depth will be about forty-eight feet, at the junction of Waterloo Road and Stamford Street thirty-eight feet, and at Hatfield Street not less than fifty-six feet.

After reaching the Middlesex or city side of the Thames, the first important road under which the tracks pass will be the Victoria Embankment, where the level of the rails will be seventy-eight feet below the surface of the roadway. Thence this electric railroad passes under the District Underground tracks, until at St. Andrew's Hill, the electric will follow the same route as the District, and so nearly that the centre line of the upper route will be the centre line of the lower, as far as Friday Street. Here they diverge, and the Electric railway continues along beneath Queen Victoria Street to its terminus directly opposite the northeast corner of the Mansion House, the official residence of the Lord Mayor, when the rails will be sixty-five feet below the level of the street. The profile of the road, with its alternate rapid descents and sharp rises, makes it look very much like a switchback railway.

The total length of the line will be about one and a half miles, and the tracks will be laid in two tunnels of cast iron, one for each direction, laid at a distance of four feet from each other. The internal diameter of the tunnels on the straight or on a flat curve will be twelve feet; on a sharp curve they will be widened to twelve feet nine inches to avoid possible contact of the ends of the cars, which will be suspended on bogie trucks, with the sides. The stations will be constructed in special tunnels, which, like those of the road itself, will be of cast iron. They will be of course comparatively spacious, the internal diameter being twenty-three feet. Both tunnels will be constructed on the Greathead principle.

The trains will run directly from terminus to terminus without stops and will make the journey in about four minutes, at an average speed of twenty-two miles an hour.

The station platform of the electric railway at Waterloo being at a depth of only thirty-six feet, elevators will not be used, the travelers attaining the platforms by a series of easy declines. At the Mansion House, however, where a distance of sixty-five feet separates the passenger from the street, huge hydraulically operated elevators will be used, and these are to be designed of ample capacity to cope with the enormous traffic which will probably fall to the road.

The details of the electrical installation have not yet been definitely determined, but with the City and South London underground and the Liverpool overhead railways as object lessons, it may be surmised that they will be even more perfect. The use of electric locomotives, as in the former road, will doubtless not be considered, the advantages in favor of the motor car, as in our own Intramural Railway, being sufficiently numerous to recommend it for this special work.

On the Surrey side of the river, near the west side of Blackfriars Bridge, a long platform was erected last June, at which time the excavation of the tunnel shaft was commenced. From near Hatfield Street, running toward the Mansion House, the two tunnels will be in London clay, but as the line rises in the other direction, that is toward Waterloo, it will meet ballast, and as large volumes of water will be encountered here, this portion of the road will be constructed under heavy air pressure, as was found necessary in the case of the City and South London Railway.

At Blackfriars, two cast iron cylindrical shafts have been sunk to a depth of forty-feet below high water mark, one above each of the projected tunnels. Below the cylinders the shafts are of brick work in cement, and the shaft over the up tunnel is about completed. The object of commencing the work by sinking these two shafts in the river is to allow of the excavated material being raised and dumped directly into barges.

As soon as the requisite depth is attained, the four protecting shields and the mechanical excavators will be lowered into position, and the driving of the tunnels will go on simultaneously in both directions. As the earth is cut away the shields will be pushed forward by hydraulic pressure, and the iron segments be let into place, each segment or ring advancing the tunnel about two feet. Mr. Dalrymple Hay is the engineer in charge.

A Caselli Commemoration Medal.

At Florence, says *L'Elettricità*, an influential committee has been constituted for the purpose of coining a medal in honor of Giovanni Caselli, of Siena, the inventor of the pantelegraph. This instrument, intended to transmit writing and designs to a distance, was first exhibited at the Italian Exhibition at Florence in 1861.

Sparking of Closed Coil Dynamos.

BY GEORGE T. HANCHETT.

This most fruitful source of trouble and annoyance to the average station engineer, is much more readily met if a knowledge of the causes and remedies is available. To some extent a closed coil commutator requires a certain amount of care, closely akin to what in common parlance is termed "monkeying." That is, the application of certain adjustments and combination of brushes and pressure on the commutator for no other good reason than that they stop the sparking. But it is also true that there are certain technical points which have a general application to closed coil dynamos, and which cannot be neglected if sparkless running is to be understood.

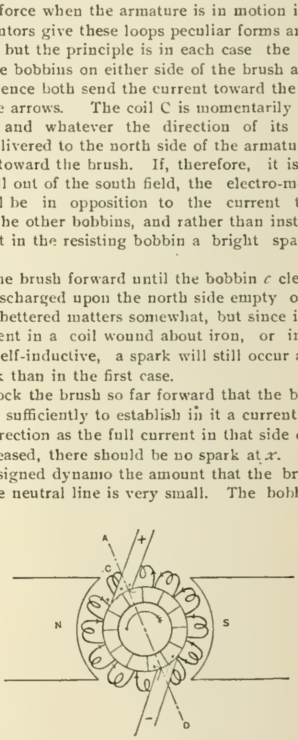
In a closed coil dynamo, whether drum or ring, the current approaches the brush in two directions from the two halves of the armature. This is shown in figure 1. In the figure are shown the commutator bars, and between every commutator bar is a loop of wire so wound around the armature core as to assist in producing electro motive force when the armature is in motion in its field.

Various inventors give these loops peculiar forms and connect in different ways, but the principle is in each case the same. It is evident that the bobbins on either side of the brush are of opposite polarity, and hence both send the current toward the brush in the direction of the arrows. The coil C is momentarily short circuited by the brush, and whatever the direction of its electro-motive force, when delivered to the north side of the armature, the current in it will flow toward the brush. If, therefore, it is released before it gets well out of the south field, the electro-motive force in the bobbin will be in opposition to the current that is forced through it by the other bobbins, and rather than instantly establish the full current in the resisting bobbin a bright spark will occur at x.

If we rock the brush forward until the bobbin c clears the south field, and is discharged upon the north side empty of all current, we shall have bettered matters somewhat, but since it takes time to establish current in a coil wound about iron, or in other words such a coil is self-inductive, a spark will still occur at x, although a smaller spark than in the first case.

If now we rock the brush so far forward that the bobbin c enters the north field sufficiently to establish in it a current equal to and in the same direction as the full current in that side of the armature where it is released, there should be no spark at x.

In a well designed dynamo the amount that the brush should be rocked past the neutral line is very small. The bobbin is of low



resistance, and the field is strong. All the electro-motive force generated is used in establishing this current in the bobbin. If the bobbin is well short circuited, only a fraction of a volt is necessary. Hence, if a carbon or high resistance brush is used it must have a thicker bearing surface than a low resistance copper brush, for the commutating bobbin must be swung further into the north field before the necessary current is established therein.

It is possible to secure sparklessness by short circuiting c for a shorter length of time in a stronger field by rocking the thin high resistance brush still further forward, but this tends to throw bobbins with reverse electro-motive force on the south side of the machine, which makes the machine work against itself and reduces the output. The bobbin should be short circuited by the brush the instant it ceases to have electro-motive force, and the brush should have thickness of bearing surface enough to hold it thus until the full current is established in the reverse direction. It is easy to see that the higher the resistance of the brush the more thick ness of bearing surface it should have.

On general principles this is so because the area of contact shoul be greater in order to transmit the main current.

This may be remedied by increasing the breadth of the brush,

but to properly commutate the bobbin, the brush of higher resistance should have increased thickness as well.

A little consideration will show that while one set of brushes may be set correctly the other is not necessarily so.

In a good bipolar machine the brushes are diametrically opposite. However, the field magnets may not establish a uniform field, and in that case diametrically opposite brushes will secure sparkless running for only one set of brushes. The other set must be set to the magnetic rather than the geometrical point of non-sparking. When the load of such a machine changes and both brushes spark in consequence, mere rocking of the brushes will correct only one set. The other must be adjusted as before, and hence such a machine is an endless source of trouble. This fault is more liable to occur with ring than with drum armatures.

Having thus obtained an idea of the way a bobbin is reversed under the brush, we are in a position to consider the various causes of sparking and their remedies.

There are several distinct kinds of sparks which appear at the brushes of a closed coil dynamo. First, those due to an imperfectly commutated bobbin, which are of a bluish, flashy nature These are not very destructive to the commutator. Second those due to imperfect or insufficient contact. These are of a deep, yellowish red color and cut deep ruts in the commutator if allowed to continue.

These two are liable to appear on a dynamo in the best of order. There are also intermittent sparks due to a local defect in the armature.

To a man not familiar with the two different kinds of sparks, their distinction is a little puzzling. The spark of the improperly commutated bobbin may be produced by rocking the brushes out of position.

The second kind may be produced by applying an excess of oil to the commutator with the brushes set correctly.

The writer does not advise any prolonged experiments of this nature with a nicely polished commutator. The information may in such a case cost too dear.

It is, however, important to distinguish between the sparks in order that the correct remedies may be applied.

The bluish spark, due to an improperly commutated bobbin, is due only to incorrect position of the brush on the commutator. Even a thin brush, if not too thin, may be given sufficient lead to stop this sparking.

If the field is unsymmetrical, as is sometimes the case, each set of brushes must be set separately at each change of load. An expert designer can often correct an unsymmetrical field by properly shaping the pole pieces.

The other kind of sparking is due to difficulties of a mechanical nature. A rough, uneven commutator may cause the brushes to jump and spark. If the commutator is not very rough, sandpaper may be used to smooth it, but if the commutator is very rough, there is no remedy but to turn it down.

Oil or foreign substance sometimes causes sparking.

The heat caused by the current will vaporize the oil under the brush and make a poor contact worse. The remedy is obvious.

If the current is so great as to cause a heavy overload, the brushes will spark. This, of course, is not the fault of the dynamo, and efforts should be made to reduce the load.

If the brushes spark intermittently, keeping step with the revolutions of the dynamo, there is a local defect in the armature. This may be due to one of the commutator bars being too high or too low, or to a loose bar.

In the case of a high bar, see if it is not also loose by gently tapping it with a mallet. If it drives back with light blows, tighten the retaining rings. Never drive a bar back into position by a heavy blow, as the insulation may be damaged.

In the case of a low bar tighten the commutator rings, if necessary, and turn down true.

High, low and loose bars occur only in very poorly made commutators.

It sometimes happens that the connection of a single bar has become loosened or broken, due to centrifugal force, magnetic drag or both.

This will cause an intermittent spark. If the commutator is truly round and smooth, the bar at fault may be distinguished from the fact that the bar in front is bitten away by the intermittent spark. This should be remedied at once, for that bar may become lower than the rest and a "flat" be produced.

In general, sparking will be avoided if the following suggestions are followed:

The commutator should be true, smooth, well made and of good material, and free from local defects.

The brush should have a smooth well, trimmed surface, with no frayed ends to make a loose contact.

It should have sufficient area of contact to carry the current.

It should have sufficient depth of contact to properly commutate the bobbin.

In the case of a set of brushes this may be secured by leading one brush a little in advance of the others. This is indeed often done. Experiment is the best guide as to how much this brush should be led.

The brushes should be set in the proper position on the commutator. Pressure of the brushes on the commutator should be just enough to stop the sparking and no more. The lighter the touch of the brush on the commutator consistently with no spark the better.

Most closed coil commutators run better with a very little oil. It should be applied very cautiously with a bit of felt.

No commutator of this type does well with an excess of oil, and a few run better without any. Experience is here the best guide.

Some manufacturers put poor insulation into their commutators. These men frown upon the use of any oil at all for obvious reasons.

Electrical Power Transmission—VI.

BY LOUIS BELL, Ph. D.

Power Transmission by Continuous Currents.

31. Case II—Series motors worked at constant potential are very widely used for electric railway service and other cases, such as hoisting, in which great variations of both speed and torque are desirable. When supplied at constant potential the speed of a series wound motor varies widely with the load. In any case the speed increases until the counter E. M. F. rises high enough to cut the current down to the amount necessary to give the torque sufficient for that load and speed.

If the field be strengthened the motor will give a certain output at a lower speed than before; if it be weakened, at a higher speed; the torque being in these cases correspondingly increased or decreased.

The torque increases rapidly with the current so that when the counter E. M. F. is small, or *nil* as in starting from rest, the torque is very great, a property of immense value in starting heavy loads. For in starting not only is the current through the armature large, but the field is at its maximum strength. If the field strength varied directly as the current the torque would vary nearly as the square of the current.

As a rule, however, these, like most other motors, are worked with a fairly intense magnetization of the fields so that doubling the magnetizing current by no means doubles the strength of the field. In fact, most series motors for constant potential circuits are of the type used for electric railways and wound so that the field magnets are nearly saturated even with very moderate currents. Hence the torque in such cases increases but a trifle faster than the current. This construction is adopted in order to reduce the amount of iron necessary to secure a given strength of field, and so to lighten and cheapen the motor.

It is quite obvious that while series motors at constant potential have the advantage of being able to give on occasion very great torque they suffer from the same disadvantage as constant current motors in that they are not self regulating for constant speed. A centrifugal governor could of course be arranged to do the work but since it happens that most work requiring great torque also requires variable speed, nothing of the kind is usually necessary.

As previously explained the speed can be easily regulated to a certain extent by hanging the field strength, thus changing the counter E. M. F., but owing to the peculiarity of design just noted, this method is rather ineffective, requiring a great change in the field winding for a moderate change in speed.

In general, when a considerable range of speed is needed, constant potential working is abandoned and the speed is changed by varying the impressed E. M. F. by means of a rheostat. If this E. M. F. be lowered, the current decreases and the speed sags off until the new counter E. M. F. is low enough to let pass just enough current to maintain the output at the reduced speed. When the applied E. M. F. is increased the reverse action takes place. Under these circumstances for a fixed load the current is approximately the same independent of the speed; for with a uniform load the torque is constant although the output (*i. e.* rate of driving the load) varies. All railway motors are regulated in the manner just described, although in addition the field strength is sometimes varied by cutting out or recombining fields. Rheostatic control necessarily wastes energy, and the greatest recent improvement in railway

ractice consists in reducing the E. M. F. applied to the car motors by throwing the two in series. This secures a low speed economically though the rheostat still comes into play at intermediate speeds.

Speaking broadly then, series wound motors while possessing some valuable properties, are limited in their usefulness by their tendency to vary widely in speed when the load changes. Hence they are "used chiefly in cases where the speed is to be varied deliberately. A typical motor of this class, such as is used for hoists and the like, with rheostatic control, is shown in Fig. 19.

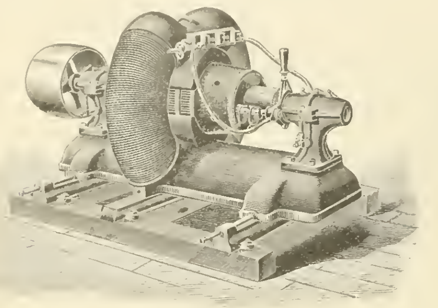


FIG. 19.

In spite of the difficulty in regulation, the series motor possesses some considerable advantages. The field coils being of coarse wire are easily and cheaply wound even in motors for very high voltage; the same quick response to changes in current or load that makes it hard to obtain uniform speed is also most important in many kinds of work; the powerful initial torque, coupled with the kindred property of prompt reversal; all these make the series motor preëminent for certain purposes, especially where severe work is to be coupled to hard usage.

There is one case, too, in which the series wound motor can be made accurately self-regulating for constant speed—a case somewhat peculiar and unusual, but yet worthy of special attention.

32. Case III—We have seen that when the load on a series motor supplied at a certain voltage increases the speed falls off until the increasing current due to the lessened counter E. M. F. raises the torque sufficiently to meet the new conditions. Imagine now that the impressed E. M. F.'s were so varied that the slightest increase of current in the motor should be met by a rise in the E. M. F. applied to it. Evidently the speed would not have to fall as before, for the greater applied voltage would furnish ample current for all the needs of the load. If the variation in voltage could be made

FIG. 20.

to depend on change of torque, not giving the speed time to change, the regulation would be almost perfect. Such a method has been proposed, but owing to mechanical difficulties has not been used to any extent.

It is possible, however, so to combine a special motor and generator that the former will be very closely uniform in speed quite independent of the load. In this connection we must revert to the properties of the series wound dynamos. If such a machine be driven at constant speed its electro-motive force will increase with the current since the strength of field, here the only variable factor in the voltage, will increase with the current. If the field magnets of the generator are unsaturated, that is not so strongly magnetized as to require considerable current to produce a moderate increase of magnetization, they will respond very promptly to an increase of load by raising the voltage. If such a generator be connected to a series wound motor of proper design, the pair will work together almost as if connected by a belt instead of a long line, and the motor will run at a nearly uniform speed, since the least diminution of speed, with its accompanying increase of current, will be met by a rise in the voltage of the generator. Such an arrangement is shown in diagram in Fig. 20.

In this Fig. A is the generator supplying current to the motor B. The machines should be of practically the same output for the generator cannot supply current except to the one motor without disturbing the regulation. Whenever the load on B changes, a very small reduction in speed suffices to raise the voltage of A and thereby hold up the speed of B. To this end the field magnets of B must be more strongly saturated than those of A, else the same increase of current would raise the counter E. M. F. of the motor and its armature reaction, and defeat the purpose of the combination. If the fields of the two machines are properly designed the generator will increase its voltage under load just enough to hold the motor at speed, as a very slight change in current immediately reacts on the generator.

It is even possible to make the motor rise in speed under load if the generator is sufficiently sensitive to changes of current. This is generally needless, but it is often useful so to design A and B that the former will rise in voltage fast enough not only to compensate for the added load on the motor but for the added loss of energy in the line, entailed by the increase of current, thus regulating the motor even at a long distance. It is needless to say that such a system must be so arranged that the generator will take care of everything that tends to change the speed. When properly adjusted the system is capable of holding the motor speed constant within two per cent. through the range of load for which the machines are planned.

It should be noted in connection with Fig. 22 that whereas the current circulating in the armature of a generator tends to disturb the magnetic field in one direction in a motor the same reaction is in the opposite direction. For the current in the motor is driven through the armature against the counter E. M. F., *i. e.* in the direction opposite to that of the current the machine would give if running as a generator. As the effect of the reaction is to skew the direction of the magnetic field that affects the armature conductors and the commutation must take place when the commuted coil is not under a varying induction, the armature reaction compels one to shift the brushes slightly away from the position they would have if the field were perfectly symmetrical. This shifting is in the direction of armature rotation in a generator, but for the reason above noted has the opposite direction in a motor, as shown in the figure.

(To be continued.)

Electrodynamic Machinery—XX.

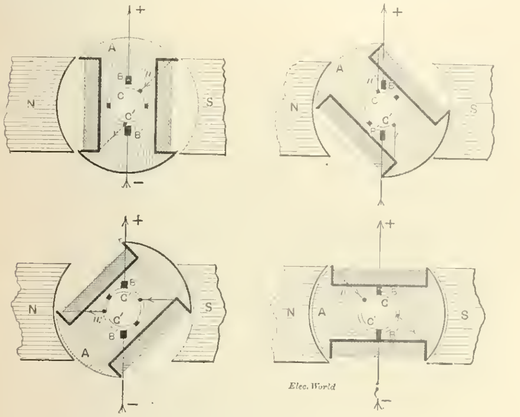
BY EDWIN J. HOUSTON AND A. E. KENNELLY.

101. Having thus obtained the value of the flux passing through the armature, it is a simple matter to determine the E. M. F. at any speed of rotation; for we have only to reconstruct the flux diagram of Fig. 85, to a horizontal scale of time in seconds, instead of angular displacement. This is shown in Fig. 86, for an assumed rate of rotation of 1.5 revolutions per second, or 90 revolutions per minute, the horizontal distance of $O\,M'$, being taken as one second, and the vertical scale being taken for convenience smaller than in Fig. 85.

The E. M. F. produced in any single loop or turn around the armature will be the rate of increase in the flux passing through the armature. If at the position O, commencing the curve, we continue the curve along the dotted tangent of $O\,O'$ for one second of time, we reach the ordinate $m\,O'$ of 770 kilowebers, and this is the rate at which flux is entering the loop at that moment; for if the rate at O, were continued uniformly for an entire second, we should evidently reach the point O'. The E. M. F. existing at the moment of starting is, therefore, 770.000 C. G. S. units (of which 100 million make one volt) or 0.0077 volt, and if the number of turns around the armature core be 1,000, the total E. M. F. in the armature winding will be 7.7 volts. Again, if after a lapse of 1-6th of a second, the flux curve $o\ a\ b\ c\ d\ e\ f\ g\ h\ i\ k\ l\ m\ n$, be examined, it will be found that the curve has reached the point b, or its maximum positive value when it commences to descend towards g, and where the tangent is horizontal, representing that the rate of change of flux is zero, or similar to the condition of slack water in a tideway. At this point, therefore, the E. M. F.

in each turn on the armature is zero and the curve of E. M. F. $O\ A\ B\ C\ D$, etc. touches the zero line.

Again at the point q, on the flux curve, if the change of flux were to continue for one second uniformly at this rate, we should follow the dotted line or tangent $q\ q'$, which reaches the ordinate —400, or 500 below q' so that the rate of change at the point q. on the curve is 500 kilowebers, represented by the point Q, on the E. M. F. curve at that ordinate. Continuing in this way we trace the E. M. F. curve $O\ A\ B\ C\ D$, etc., showing that an alternating E. M. F. is produced in the armature, varying between + 7.7 and — 7.7 volts. At the rate of rotation assumed, namely $1\frac{1}{2}$ revolutions per second, there will be three alternations of E. M. F. per second, or twice the number of revolutions in that time.



Figs. 81, 82, 64 and 83.

102. Having now examined the means for determining the value of the E. M. F. developed in the armature, we will consider the effect of the commutator. It will be seen by reference to Figs. 81 to 84, that the brushes B, B' resting on the segments of the two-part commutator, the direction of E. M. F. from the armature towards the external circuit is reversed at the moment when the core passes the position of maximum contained flux, as indicated by the change in the direction of the dotted loops $C'\ D'\ E'$ and $L'\ M'\ N'$, relatively to the horizontal line. The E. M. F. generated by the armature is produced at the brushes B, B', will be represented by the pulsating E. M. F., $O\ A\ B\ C'\ D'\ E'\ F\ G\ H\ I\ K\ L'\ M'\ N'$. It is evident that had we selected a higher rate of rotation the E. M. F. of the machine would have been correspondingly increased.

103. The preceding considerations can only determine the value of the E. M. F. at the brushes, while the external circuit is open. As soon as the circuit of the armature is closed, the E. M. F. at the brushes is reduced, for the following reasons; viz. because,

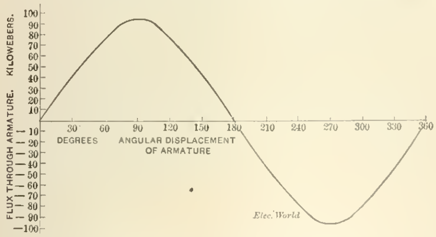


Fig. 85.—Diagram of Flux Passing Through Armature in Different Angular Positions.

(1). The current in the armature produces an M. M. F., always counter, or opposite to the M. M. F. of the field magnet, and, therefore, diminishes the flux through the magnetic circuit, thus causing a corresponding diminution in the value of the E. M. F. produced. Indeed, this opposing M. M. F. may, under certain circumstances, assume a magnitude sufficient to neutralize and destroy the permanent M. M. F. in the field magnets. This is one of the reasons why magneto generators are not employed on a large scale in practice.

(2.) The current through the armature produces in the resistance of the armature, a drop in the E. M. F. If, for example, the current through the armature at any instant be one ampere, and the resistance of the armature be 10 ohms, then the drop of E. M. F. produced in the armature will, in accordance with Ohm's law, be $1 \times 10 = 10$ volts.

(3.) The current through the armature not being steady, but pulsating, the variations in current strength will induce E. M. F.'s

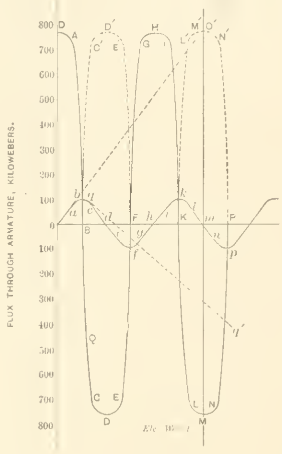


Fig. 86.—Diagram of Flux Passing Through Armature at Different Periods of Time.

in the coil opposed to the change and, therefore, reducing the effective E. M. F.

(To be continued).

Laboratory of Houston & Kennelly, Philadelphia.

Electrical Difference of Potential—An Analogy.

To the Editor of The Electrical World:

Sir:—In the article by Mr. John Waddell, printed in The Electrical World of Dec. 8th, giving a mechanical analogy of the generation of an E. M. F. in a conductor moving across a magnetic field, it is stated that the friction of the steel wires on the sides of the box requires an expenditure of energy when the box is moved, and that this is analogous to the expenditure of energy required in moving a conductor across a magnetic field to generate an E. M. F.

No energy is required to move a conductor in a magnetic field other than that required to overcome the friction, inertia, etc., of the conductor, so long as no current is flowing in the conductor in any direction; that is, none of the energy required to move the conductor can be charged to the generation of the E. M. F., so it would seem that, in this respect at least, the analogy is imperfect, although in its other features it seems to be a very good one.

Scranton, Pa. A. W. K. Peirce.

To the Editor of The Electrical World:

Sir:—The criticism of my article made by Mr. Peirce seems at first sight to be well founded; but there is an argument which induces me to believe that it is incorrect, and I shall describe an experiment which, if there is no error in the way in which it was carried out, leads to the same result.

I understand Mr. Peirce's criticism to be this:

Work is done in the air box, described by the motion of the paddles, because of the flow of air from one end of the box to the other, whereby compression and rarefaction are effected. This work is due merely to the friction of the air in its passage, because the heating produced in the air that is compressed is counterbalanced by the cooling in the rarefied air.

Mr. Peirce conceives that there is nothing correponding to this phenomenon in the case where difference of potential is created by the movement of a wire across a field of force. The formula, $W = E\ C\ t$ is, I suppose, the basis of his assertion; the current being zero, the work would be zero. I think, however, that this formula does not warrant the conclusion drawn in the above instance.

In a statical machine of the old type, the knob connected with

the rubber becomes, in the old phraseology, negatively electrified, and the knob which is charged from the glass, positively electrified. In other words, there is a difference of potential produced between the two knobs. If connection is made between the two a spark will pass, which shows that work must have been done in creating the difference of potential. The case is analogous if a wire is moved across lines of force. Suppose the conditions to be such that the one end of the wire is of one hundred volts higher potential than the other. If the conduction is uniform, and the field of force uniform, the potential of a plane cutting across the middle of the conductor is fifty volts higher than one end, and fifty volts lower than the other. Let the wire be supposed instantaneously cut at this place, and let the motion of the parts then cease. In each half the potential will equalize itself throughout; but manifestly, the potential of one half will be fifty volts higher than that of the other. If connection is now made between these two parts, there will be a transference of electricity, and work will be done, which work must have been performed on the conductor, by its motion across the field of force.

A way in which a wire may cut lines of force, is for the wire to remain stationary, but the field of force to vary. If an insulated wire run by the side of a wire in which an alternating current is passing, each end of the insulated wire will be alternately of higher and lower potential than the other; and if my argument be correct, and work be done in the variations of potential, the wire should be heated. Therefore, in the ordinary transformer, even if the secondary circuit is open, heat should be developed in it. I am not in a position to make the test, and I am doubtful whether the rise in temperature *could* be detected, because of the small capacity of the circuit. (If my letter were not already so long, I should explain in what way I consider that the capacity affects the matter, but perhaps explanation is unnecessary). The telephone is a more delicate instrument than the thermometer, and should, in the case suggested above, emit sounds when inserted in the insulated line. I tried a corresponding experiment with a Ruhmkorff's coil. It is well known that if a telephone be inserted in the secondary circuit of a Ruhmkorff's coil, it will emit loud sounds. I joined the telephone with *one terminal only*, of the coil, the other terminal having no wire attached. No sound was heard in the telephone, but *when the capacity of the line was increased* by connecting it with the inside of a large Leyden jar battery, the outside of which was put to earth, *sounds were quite audible.*

Again when the Leyden jar battery was inserted *between* one terminal of the secondary coil and one binding screw of the telephone, the other binding screw of which was joined *directly* to the other terminal of the coil, the *sounds were almost as loud* as when a complete circuit was made through the telephone. In this case the capacity of the line was larger than by the other arrangement of the Leyden jars, and the work done in the telephone was greater.

Incidentally, while planning some experiments with a view to throwing light on the point just discussed, I passed the interrupted current of the primary of a Ruhmkorff's coil through a voltameter, and noted the amount of the mixed gases produced, in a given time, both when the secondary circuit was closed and when it was open. In the former case, the amount of gas produced was greater than in the latter, in about the proportion of seven to four. This is an easy lecture experiment, illustrating the difference of counter electric-motive force, in the primary circuit of a transformer, the secondary circuit of which is without or with load.

John Waddell.

Royal Military College of Canada, Kingston, Ontario.

Consumption of Alternating Arcs.

To the Editor of The Electrical World:

Sir:—In The Electrical World of Dec. 15, I notice an interesting communication from Messrs. Bedell and Crehore by which an explanation of the unequal consumption of alternating arc carbons is attempted. While I agree with the authors that with an unsymmetrical alternating current the consumption may become unequal in case the energy expended during successive semi periods is not equal, I cannot admit the hypothesis which I find here implied, namely, that an increase of electrical energy—the electric quantity remaining constant—shall generally produce a greater waste of the carbons. With the view of completing their demonstration you will permit me to offer my own explanation of the phenomenon.

The thing that has first to be explained is the higher temperature of the positive carbon terminal of a continuous current arc. This temperature difference, according to my theory, is based on the action of a thermo-electricity. It is an experimental fact that the passage of a current through heterogeneous substances causes—independent of the Joule effect—evolutions or absorption of heat at the places of contact. In a circuit of iron and copper for instance, a current will cool the junction in passing from copper to iron and heat the other junction in passing from iron to copper. Now in a circuit consisting of carbon and an arc we must expect the same thermal effects to occur. In fact the excessive heating of the positive carbon is such a phenomenon; the negative pole is simultaneously cooled. This view can be fully substantiated by electro-chemical considerations. In fact the Peltier effect and the thermal phenomena of a voltaic cell are very closely related. The transfer of electric quantity between the poles of arc carbons is analogous with the transfer of electric quantity between the electrodes of a galvanic cell; this transfer being effected in both cases by ions or atoms. The latest views of electro-chemistry make this analogy still more striking, for the behavior of the ions in elctrolytic solutions is perfectly identical with that of gases. Electrolytic dissociation into ions has to precede the transfer of electricity, and so with an arc the dissociation of the gases has to precede discharge. We see then that the absorption and evolution of heat of the arc carbons, which is proportional to the current, is exactly the same thing as the thermal effects we are so well familiar with at the surface of contact of electrodes and the solution in which they are immersed. That the higher temperature f the positive carbon causes a more rapid waste is natural.

We will now consider what we must expect to take place under such conditions as are assumed by Messrs. Bedell and Crehore.

Suppose we have an alternating current whose positive waves and negative waves are of unequal energy but of equal quantity.

Let the current from A to B have the greater energy. Then it is necessary that the square root of the mean square of the instantaneous values of this waves E. M. F. should be larger than that of the opposite wave from B to A. Remembering now that the E. M. F. is proportional to the rate of cutting the lines of force and assuming that the semi-periods are of equal duration, we must conclude that during a relevant portion of the semi-period $A - B$ the rate of cutting the lines of force, and consequently the current, is greater than that during a like portion of the semi-period of B to A. Now since the evolution of heat due to the Peltier effect is directly proportional to the current, it follows that during the semi-period $A - B$ a relevant portion of heat is developed in shorter time than a comparable quantity of heat during the semi-period B to A. From the general laws of radiation we know that the rise of temperature of the body is necessarily the greater, the shorter the time during which we impart heat. The temperature of A will therefore exceed that of B and the waste of A will be greater. We see then, that there is no direct connection between electrical energy and consumption of carbon, as we have shown that in general the waste of carbon depends on the magnitude of the current and of course on the length of time during which a certain quantity of electricity is being transferred.

Ithaca, N. Y. Alfred H. Bucherer.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir:—I wish to correct a slight mistake in the automatic cut-out suggested by Mr. A. H. Burnett in your issue of Dec. 8, although the majority of your readers may have already noticed it.

He proposes to connect a magnet with a polarized armature, in shunt with the armature of a generator running in parallel with others, so that in case the generator starts to run as a motor and takes current from the bus bars, the polarity of the magnet will be reversed, causing it to repel its armature, and close a contact in the circuit of another magnet operating a switch, and thus cut out the generator.

The error is in assuming that the polarity of the generator will be reversed in the event of its running as a motor. A few moments thought will show that its polarity does not reverse, but its E. M. F. simply falls below that of the bus bars and allows the current to flow back through it against its own E. M. F., which corresponds exactly to the counter E. M. F. of a motor. The only way its E. M. F. could become reversed is by its taking so much current that the series field winding entirely overpowers the shunt and reverses the polarity of the field. This could not happen if an equalizer were used, so it is safe to say it never does happen in a railway power station.

His arrangement would work all right by placing it in series with the armature instead of in shunt with it.

New York, N. Y. M. P. Ryder.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Tesla Effects With Influence Machine.—The first part of an abstract of a lecture by Dr. Toepler (inventor of the Toepler-Holtz machine) is published in the "Zeit. fuer Elek.," Dec. 1. He describes a number of experiments made with his multiple plate machines, and shows the advantages of using such a machine with 20 plates for making researches with high frequency currents; the machine itself is well known, but was improved slightly to increase the self-excitation and the intensity of the current for a very high voltage. He shows its application for producing some of the Hertz effects and states that it gives two different kinds of primary sparks. With this machine the fundamental experiments of Tesla can be demonstrated, although it consumes only 1-16 to 1-18-hp; better results were obtained with a 60-plate machine requiring ⅛-hp. The connections are the same as usual, the machine discharging through a spark-gap, the poles of which are connected to condensers whose outer coatings discharge through the primary of a transformer, the secondary current of which is used to produce the effects; with a large machine he obtains 100 sparks per second 3 mm. long; one of the chief advantages of using influence machines is that it gives the high tension and high frequency alternating currents directly; also that a better symmetry is obtained, for with an unsymmetrical system, discharges in one direction are obtained which are disturbing; no air-blast or magnetic field is in this case necessary to rupture the current in the spark-gap and to this he attributes, in part, the success of the results. A Geissler tube in this circuit shows the cathode light at both poles which proves that the current is an oscillating one, while with a Ruhmkorff coil the cathode light is produced at only one pole. The article is to be continued.

MAGNETISM.

Curious Magnetic Phenomena.—In the Lond. "Elec.," Dec. 7, Mr. Burnie gives the results of some experiments made to explain the phenomena described by Mr. Lloyd (see Digest, Dec. 15). Mr. Lloyd's experiment was made with magnets which had previously been broken, whereas the present writer began with an unbroken bar magnet; in this he found that when magnetized, there were two consequent poles somewhat resembling those obtained by Mr. Lloyd; he then tried by a number of different methods of magnetization, to destroy these, but in every case the result was similar to that at first obtained; the same results were also obtained with other bar magnets of different lengths, though they were much less marked with short magnets; he finds that the ends of the bar were harder than the centre, that there was a rapid change of hardness at the consequent poles, and that the magnets were liable to break at the consequent poles; he believes that the ends induce the consequent poles in the more permeable central portion; on breaking these magnets it was found that they broke easily at these consequent poles; when broken elsewhere no such reflection of the cracks was obtained; he concludes among other things that in many bar magnets there are consequent poles due to the variations in the hardness in steel, that bar magnets usually break at one of these poles, that they are usually symmetrical and that the apparent image noticed by Mr. Lloyd was due to one of these consequent poles and not to the break.

Change of Length With Magnetization.—A paper by Mr. Nagaoka from the "Weid. Ann.," Vol. 53, page 487, is briefly abstracted in the "Elek. Zeit.," Dec. 16. He used the ovoids of Prof. du Bois, made of iron, nickel and cobalt; the curve for the square of the magnetization and the elongation resembles a hyperbola for iron and cobalt; for nickel it differs from a straight line only with strong magnetization; for weak magnetization the changes of length of all three metals varies in a linear ratio with the square of the magnetization, according to Joule's law.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determination of the Conductivity and the Dielectric Constant.—In a paper by Dr. Nernst published in the report of the meeting of the German Electro-Chemical Society, he discusses an apparatus for measuring the dielectric constant which can be used also for determining the conductivity and the polarization constant; it consists in general of a bridge, two arms of which are resistances, the other two containing the condensors which are shunted, the latter being important, for without this shunt the method cannot be used owing to the fact that the dielectric is not an absolute insulator; an alternating current and a telephone are used; very rapid oscillations are essential. Dr. Froelich called attention to a slight error in the results.

Measuring Coefficients of Induction With a Telephone.—An article by Mr. Heydweiler from the "Weid. Ann.," Vol. 53, page 499, is abstracted briefly in the "Elek. Zeit.," Dec. 6. He shows that contrary to the experience of Foster, the telephone can be used instead of the galvanometer if slight changes are made in Foster's method.

Electro-Chemical Actinometry.—The original paper of Mr. Marechal, mentioned in the Digest Dec. 15, is published in full with illustrations in the "Bul. Soc. Int. des Elec." for November.

Bolometric Investigations.—A translation of a paper by Messrs. Lummer & Kurlfaum from the "Weid. Ann.," Vol. 46, page 204, 1892, is published in the Lond. "Elec.," Dec. 7.

Alternate Current Measuring Instruments.—In a discussion published in the "Elek. Zeit.," Dec. 6, Mr. Dobrowolski stated that alternating current measuring instruments with iron are of use only for the particular current curves with which they have been calibrated; it is not possible to have such instruments with saturated iron, as the saturation exists only during a portion of the time of the current impulse, the result of which is that the curve representing the field in the iron does not correspond at all with that of the surrounding coil and that neither a mean nor a quadratic value of the curve can be found from the deflection; the scale will change with every different current curve, not according to any simple ratio, but quite irregularly.

Imperial Reichsanstalt.—A paper by Dr. Feussner on the work of this department is published in the "Elek. Zeit.," Dec. 6; it is quite general in character.

Board of Trade Laboratory.—The Lond. "Elec.," Dec. 7, publishes three large photographic views of the interior of this laboratory, photographed with the aid of an arc light, magnesium light having been found unsuitable.

DYNAMOS AND MOTORS.

Alternating Current Motor System.—In the "Elek. Zeit.," Dec. 6, Mr. Schulz describes a system used by his company which appears to be similar to that of the General Electrical Co.; the exciter is coupled mechanically with the alternator, and besides supplying the continuous current for the fields it generates an alternating current, whose phase is shifted 90 deg. relatively to that of the alternator; a third circuit running from this machine leads this current to the motors where it is used to start them.

Unipolar Dynamos—Mr. Contades in "Cosmos.," Nov. 24, describes, with the aid of an illustration, a machine which has been constructed; it consists essentially of four unipolar disk machines somewhat similar to the Forbes type, but differing in the form of magnet used; two of the disks are on one shaft and two on another, the two shafts being rotated in opposite directions and the disks being connected in series through four sliding contacts; each disk is furthermore divided into 12 sections, each having a separate ring and brush contact, enabling the twelve sections to be connected in series.

E. M. F. and Current Curves of Alternators.—The article abstracted in the Digest, Dec. 15, is published in full with all of the numerous illustrations in "L'Eclairage Elec.," Nov. 24.

Combined Dynamos and Turbine.—The Hall combination is illustrated and briefly described in the Lond. "Elec.," Dec. 7.

TRANSFORMERS.

Open-Circuit Loss in Transformers.—The Lond. "Elec.," Dec. 7, publishes a short but interesting article by Mr. Partridge in which he gives, in the form of curves, the results of some prolonged measurements which show an increase in the open circuit loss in transformers after they have been working for some time; he believes that this fact has not yet been published by any one; he claims that this is of special importance to transformer makers, who are called upon to guarantee the performance of their plant for a specified period. A large number of experiments show that this increase of waste of power is due to a molecular change or fatigue in the iron, and not to dampness or deterioration in the insulation as might be supposed at first sight; in the latter case, the power factor would increase as the insulation decreased, but his observations show that the power factor remains substantially constant; to prove that the results were not due to the atmosphere he made tests with carefully sealed transformers during a period of four months and compared it to a similar transformer used only when measurements were taken; the power taken by the former showed an increase, while that of the latter remained constant. Two of the curves were taken from 750-watt transformers, one of them beginning with a

loss of 145.1 watts and increasing in 180 days' continual running to a value almost 40 per cent. higher; the original loss in the second was 60.8 watts, which increased almost 30 per cent. in about 30 days and 40 per cent. in about 90 days; the third was for a 15,000-watt transformer working regularly at a sub-station; the original loss was 63 watts, which was increased 40 per cent. in about 6 days after which it varied but averaged about the same.

In a note by Prof. Ewing, he states that the results are so interesting and important that further particulars would be very desirable; it would be interesting to know how the losses were measured, what the value of the induction was, etc.; the observations apparently point to the change in the magnetic qualities of the iron resulting from a repetition of the magnetizing processes; he suggests finding by measurement whether the area of the hysteresis cycle is altered by this exposure to many reversals; it is well known that in a new piece of iron the values of the induction continue to contract appreciably during some scores of reversals, and it would now seem that such a change goes on during millions of cycles resulting in an enlargement of the area relatively to the value of the induction; the effect has an interesting correspondence in what is known as the cumulative influence of repeated strains on the mechanical qualities of metals; Lord Kelvin found that this fatigue tended to disappear during an interval of rest, and it is natural to look for a similar restoration of the magnetic quality through rest: this, together with other reasons, shows that it is desirable to cut out the transformer when it is not doing useful work. Editorially it is stated that this phenomena is new only in a relative sense, intimating that it was known before.

ARC AND INCANDESCENT LIGHTS.

Scientific Study of Arc Lamps.—A ninth paper by Mr. Kennedy is contained in the Lond. "Elec. Rev.," Dec. 7. He discusses series lamps; when running on constant current they are regulated by variations in pressure only; he states that it is important to use a constant current in testing such lamps, for if the current is variable and if there is a main coil (series coil) in the lamp, the test is worthless as far as it concerns series working; it is sometimes claimed that lamps regulated on a variation of one-half a volt, which he says may be corrected when the current also varies and when there is a series coil, but with a series lamp with no series coil one-half the voltage is powerless to feed any lamp in existence. He recommends the use of 120 volts instead of 100 for general use from central stations, partially because with the former three lamps in series may be used.

Gas Lighting.—A new device for producing a succession of sparks at the end of the burner by means of a toothed wheel operated by a pendant or by the stop-cock itself, is described and illustrated in the "Elek. Anz." Dec. 6.

ELECTRIC RAILWAYS.

Traction.—The discussion of the institution papers of Wilkinson, Blackwell, Dawson and Preller is published in the Lond. "Elec." and "Elec Rev.," Dec. 7. Mr. Parshall states that the trouble due to earth returns might have been avoided to a great extent "had these return circuits been put in according to principles that were thoroughly well understood; in discussing the bonding of the rails he states that experience with polished copper contacts show that a current density of 300 amperes per square inch for currents up to 500 amperes should not be exceeded, and that for greater currents such a high density was not permissable; with iron contacts, especially when liable to corrosion, 50 amperes per square inch was as high as was safe in most cases; if 1,000 amperes per square inch is taken as the mean permissable density in bonds, the contact should be 20 times the section of the bond; for very large currents he recommends welding the joints. A fair value for the amount of energy taken by ordinary cars from 8,000 to 10,000 lbs. running at 8 to 12 miles per hour, he says is one kilowatt hour per car mile; the current for starting is 40 to 50 amperes with the series parallel controller and corresponds to a horizontal effort of 1,600 to 2,000 lbs. at a periphery of a 33-inch wheel and accelerates the car about two feet per second; the energy taken per car mile remains fairly constant through a wide range of speed. He gave curves (not published) showing the speed, torque and efficiency of a good motor. Regarding the application of alternating currents, he states that the properties of the induction motor, as shown by a curve for the speed and torque, were not such that it compared favorably with continuous current motors for ordinary railway work, but the indirect application of alternating currents to drive commutating dynamos was being successfully carried out; experience in the United States direct connected railway dynamos gave results which were most gratifying. Captain Sankey discusses the strains on the machinery due to short circuits or overloads; with belt driving he does not think the stress so produced would lead to accident because the energy in the fly-wheel was discharged directly into the belt and not through the spokes; with a direct driven dynamo the energy of the fly-wheel had to be discharged through the spokes, and that these stresses might be serious with slow speeds there is no doubt, but there is no risk with small disk fly-wheels at high speeds; he believes that it is not the engine but the armature of the dynamo that would suffer damage by the fly-wheel; he proves this from some calculations which he gives and finds that there is still an ample margin left; in direct driven sets it is only necessary to make the shaft and the armature windings sufficiently strong. Mr. Holroyd Smith described a trolley pole, wire clip, trolley wheel, and rail bond, devised by himself, which are illustrated in the "Electrician;" he advocates the double tread rail and wheels with the centre flange, a plan which had been adopted in Buda Pesth, which he considers the best example of electrical railway.

Alpine Railway.—Some further information about the proposed electrical railway to the top of the Jungfrau (one of the highest snow-capped mountains of the Alps) a brief account of which was given in the Digest, March 17, is given in the "Zeit. fuer Elek.," Dec. 1. The total cost is estimated at $1,600,000 for a length of 7.38 miles, a large portion of which is in a tunnel, half-tunnel or under glaciers; the electrical installation and cars are estimated at $70,000; it is estimated that 10,000 passengers per year will be carried to the Eiger Station and 7,000 to the top; the cost of the round trip is to be $9; the question whether passengers could ascend so quickly to such a great height without being injured, was answered favorable by an aeronaut, who stated that he had not experienced this sensation in making ascensions up to 13,000 ft.

Canal Boat Traction.—According to the Lond. "Elec.," Dec. 7, a recent trial was made of the Bovet system on the St. Denis Canal; a series motor operated a towing pulley over which a chain passed, which when not in use rests on the bottom of the canal; this chain passes over the pulley for only three-quarters of a turn, being held by friction produced by the magnet which constituted the pulley; the current was taken from trolley wires; the results were said to be very successful, and showed that with 2,000 watts it was possible to obtain a speed of 1.68 miles per hour with a barge weighing 300 tons.

Street Railways.—The article mentioned in the Digest, Dec. 15, is concluded in the "Zeit. fuer Elec.," Dec. 1; a large number of estimates of cost are given in detail.

Dynamometer.—The Lond. "Elec. Rev.," Dec. 7, abstracts from the "Engineer" a description of the car used in testing the Heilmann locomotive.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Regulation of Three-phase Installations.—A paper by Mr. Lahmeyer, describing his system of regulation when the current is transformed into continuous current, is published in the "Elek. Zeit.," Dec. 6; it appears to be similar to that suggested by Swinburne, and consists in regulating the phase and the voltage.

Accumulator Stations in Berlin.—A description of some length, including illustrations of the system of connections, of a station supplying a section of Berlin is given by Mr. Rathenau in the "Elek. Zeit.," Dec. 6.

Electricity on Board Ship.—A paper by Mr. Gibbings is abstracted in the Lond. "Elec. Eng.," Dec. 7.

WIRES, WIRING AND CONDUITS.

Inductance in Aerial Lines.—The article by Prof. Blondel (see Digest, Dec. 15) is concluded in "L'Eclairage Elec.," Nov. 24. He discusses simple methods for making numerical calculations of linear inductances; the formulas require the use of a table of logarithms, and in order to dispense with these he publishes two tables, with their corresponding curves, in which he has calculated once for all certain constants, namely, the mutual inductance per unit of length for a number of distances between the axes of the two wires, and the self-inductance per unit of length for different radii of the wire; the results are given both in C. G. S. units and also in millihenrys per kilometer; with the aid of these tables all the calculations can be readily made. He speaks of a very useful quantity which he calls "factor of reactance," which is a ratio of the reactance of a circuit to its homic resistance, and gives tables and curves of the values of this factor for studying single and three-phase circuits. He shows how the results may be applied for calculating the voltage at the beginning of a line. In summarizing his conclusions he states that in comparing the different systems of circuits with regard to the voltage lost, he has proved that the lines consisting of three wires forming an equilateral triangle are the best, but in general the dissymetry induced by placing them in one plane is not appreciable; that triphase lines in general have a negligible inductance, at least many times less than that of a single phase line of the same power, and that it is preferable to diphase circuits; that the latter should be classed between the two others, as far as the inductance is concerned, but that they present even with equal charge an important dissymetry in voltage, which is too often overlooked and which makes it inferior, theoretically at least, for long distance transmissions, and there is, therefore, no longer any reason for using it, as it is possible to convert triphase into diphase currents and vice versa; it furthermore involves an expense of copper which is absolutely useless. The importance of the induction effects may become considerable for single-phase lines with the high frequencies used in America, but the three-phase circuits overcome this inconvenience, and their superiority, therefore, remains incontestible from this point of view, as also in regard to weight of the copper.

Telephone Loops Without Induction.—In order to avoid the induction disturbance between one double line and another, the German Telegraph Department runs a pair of these loops in such a way that the two planes through the two loops are at right angles to each other; this answers the purpose, but can be used only with two loops. An arrangement which may be used for any number of loops on a pole is described and illustrated in the "Elek. Zeit.," Dec. 6; the two wires of the same loop are

nine inches apart on the same support, but the supports are 25 inches apart vertically, and are alternately on the right and on the left side of the pole; the principle is, to keep the two wires of the same loop close together, but separate them as much as possible from the other loops; the system has been tried on long lines with success, and will probably be used universally by the German Telegraph Department.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Transmission of Time in the United States.—Mr. Pellissier's article mentioned in the Digest last week is published in full with a number of illustrations in the "Bul. Soc. Int. des Elec.," for November.

Submarine Telegraphy.—The article by Mr. Marcillac, mentioned in the Digest, Dec. 15, is continued in "L'Eclairage Elec.," Nov. 24; he describes in detail the Terrin apparatus.

Watchman's Controller.—A system is described and illustrated in "L'Elec.," Dec. 1.

ELECTRO-CHEMISTRY.

Limits of Electrolysis.—In a paper by Dr. Le Blanc, published in the report of the meeting of the German Electro-chemical Society, he discusses the want of agreement between theory and experiments in the application of the Thomson law; the paper and the discussion should be read in their entirety. The law applies directly when the E. M. F. does not change with the temperature, but in other cases, which constitute the majority, the temperature coefficient must be taken into account; he discusses the effects of pressure on the liberated gases in the electrolysis of water, and states that as the pressure is diminished, the E. M. F. decreases, being almost zero, when the pressure is nearly zero, in which case water may be electrolized with an exceptionally small E. M. F.; this should be taken into account when applying the law, as the calorific equivalent for constant volume is independent of the pressure, which shows that there can be no direct connection between this equivalent and the electrical energy. He discusses the effect of using different electrodes and finds that with some there is only a momentary current when the E. M. F. increases, until it reaches a certain value, at which continuous decomposition takes place, even though they are all chemically inert; the E. M. F., also depends on the concentration of the two gases on the electrodes, but is almost independent of the nature of the electrolyte; he states that it is possible to construct a cell which gives off the same gases at two poles, differing only in their concentration.

Electricity Direct from Coal.—Mr. Powell, in the Lond. "Elec. Rev.," Dec. 7, makes a suggestion which is given in full in THE ELECTRICAL WORLD last week, p. 637.

Source of Current for Analyses.—In a paper by Dr. Heim in the report of the German Electro-chemical Society, he recommends the use of accumulators charged with Daniell cells for chemical laboratories, when it is not possible to use a dynamo or to connect with a central station. He suggests using two accumulators, charging them continuously with 12 Daniell cells, with a current of 0.1 to 0.2 amperes, the capacity of the accumulator being about 15 ampere-hours; the accumulators will cost $2.25 each, and the 12 cells, $4; he counts on an output of about 1,000 ampere-hours per year; the consumption of sulphate of copper will be about 330 pounds per year, and that of the zinc, 66 pounds per year.

Decomposing Composite Anodes.—In a paper by Dr. Vogel, published in the Report in meeting of the German Electro-chemical Society, he discusses theoretically the decomposition or solution of anodes consisting of a number of chemical substances.

Accumulators Under Water.—A correspondent to Lond. "Lightning," Dec. 6, states that during a recent flood a number of the accumulators in his house were covered with two feet of water for about four days, during which time they continued to supply the light without suffering any damage; the high specific gravity of the acid prevented its being displaced to any extent by the water.

MISCELLANEOUS

Globular Lightning.—An interesting summary of the knowledge existing on this subject is given by Prof. Sauter, in the "Zeit. fuer Elek.," Dec. 1. The following are some of the statements which he makes: These balls of lightning last from one to ten seconds, and even for several minutes; they move slowly from the clouds to the earth and can be followed by the eye, their speed being compared to that of a bird or the running of an animal; they seldom occur without being accompanied by other lightning discharges; sometimes they disappear silently, and sometimes they explode with a noise which is as great as the discharge of 100 cannon; sometimes they travel about without apparently following any law; the light given off is not very great; their size varies from that of a small ball to that of a large millstone; they may revolve, give off sparks or separate into small globes; at times they are accompanied by a slight hissing noise and leave a strong odor of sulphur; a peculiar property is that they sometimes bounce on the floor like a rubber ball, and at times the globe passes through small openings changing its form as if elastic, afterwards becoming again a sphere; sometimes they disappear in a brook or are carried away by the wind; it has happened that they pass through the floor or other subjects in a house making holes through them, but without igniting them; their actions on human beings are different, sometimes they have no effect at all, while at other times they give severe shocks, producing wounds and even death; they seem to be no more frequent in any particular country, nor do they depend on the season. It has been suggested that globular lightning is perhaps only an optical delusion, being perhaps only prolonged images of a dazzling bolt of lightning, and that it has no actual existence; Sir William Thomson (Lord Kelvin) expressed this view in 1888; but it is remarked that the phenomenon has been observed simultaneously by a number of different persons; Arago collected a number of reports and Sauter recently published a complete description of 213 cases of globular lightning. Planté reproduced an analogous phenomenon experimentally, and according to him it appears to consist of glowing, rarified air and water vapor, the presence of the latter favoring the result and determining the color, which is red when much water-vapor is present, and bluish when there is little; Planté concludes that it is a partial slow discharge or a discharge by influence, of the clouds whenever the electricity is present in exceptionally large quantity. More recently Mr. Lepel produced the phenomenon by means of a powerful influence machine, a description of which was published in that journal in 1890, page 487. The author concludes with a list of the points which should be observed in recording this phenomenon.

Practical Application of Ozone.—The Lond. "Elec. Rev.," Dec. 7, publishes a translation of the paper by Dr. Froelich, which was abstracted in the Digest, Nov. 17. In a few introductory remarks by "E. A.," that writer does not agree with Froelich on the advantages or disadvantages of ozone in rooms; an important point is to avoid an excess of ozone; it is also claimed that Froelich obtained only an infinitesimal proportion of the ozone, which would render such an apparatus practically prohibitive for commercial use; it is intimated that much higher results are obtained by modern ozone generators.

Removal of Naevi by Electrolysis.—A paper on this subject by Dr. Cagley, from the "Clinical Journal," is reprinted in Lond. "Elec. Rev.," Dec. 7.

Magnetic Treatment of Zinc Ores.—"L'Elec.," Dec. 1, abstracts briefly from "Engineering," Sept. 28, a description of a process, which has recently been applied to an ore which was too poor to be worked by any other process; the results obtained were very satisfactory, as the material separated contained 42 per cent. of zinc; the mineral thus separated is partially reduced by heat until the oxides of iron become sufficiently reduced to have magnetic qualities, after which they are treated again.

Proceedings of Societies.—The stenographical reports of the second annual meeting of the German Union of Electricians at Leipzig in June, is published in the "Elek. Zeit.," Dec. 6; most of the papers have already been published and abstracted; the present report contains little of interest technically.

Movable Roof.—A translation of the description mentioned in the Digest last week is published with illustrations in the Lond. "Elec. Eng.," Dec. 7.

The Digest for 1894.—During the past year there were published in this department, 2,923 abstracts and references, or about 56 per issue; the largest number in any one department was 417, the next largest being 373, under Units, Central Stations, Plants, Systems and Appliances, Measurements and Instruments. These abstracts and references are a summary of what was published in over 900 issues of journals, of which about two-thirds were published in a foreign language, thus averaging nearly 20 periodicals per week. Some important changes in this department will begin with the next issue.

New Books.

ELECTRIC LIGHT AND POWER. Giving the Result of Practical Experience in Central Station Work. By Arthur F. Guy, A. M. I. E. E. London: Biggs & Co. 352 pages, 47 illustrations. Price, $1.75.

The author in his preface states that the object of this book is to record and explain that information only which may be termed useful practical knowledge, though in carrying out this plan the principles underlying the action of apparatus, where necessary, are discussed briefly to enable the idea to be more intelligently grasped. In the first chapter a historical account of the electric light and the dynamo is given, followed by a resume of the progress made in electric lighting traction. In the section devoted to the latter we are surprised to learn that of the 750 street railways in the United States in 1893 "by far the greater number are run by two systems, the Thomson-Houston and Sprague's, the other being run by several minor companies." A comparison of the relative advantages and cost of electricity and gas will be found of interest by those engaged in electric lighting who have occasion to use arguments on these points.

The second chapter is perhaps the most valuable in the book and deals with motive power. Here, as elsewhere throughout the volume, the questions of cost of operation are gone into extensively, and the timely subject of gas engines is particularly well treated. The third and part of the fourth chapters deal with the theory of electricity, magnetism and electrical machinery in a very elementary way. This part of the book gives little beyond the usual "primer" instruction, and therefore will interest those only who have little or no electrical knowledge, though these will appreciate the practical form in which the information is given. The fourth chapter concludes with some useful informtion on parallel working, cost and output of dynamos, and a section of a dozen pages of practical notes on running will be appreciated by the dynamo-man. Chapter V, is principally on arc lighting, which is very well

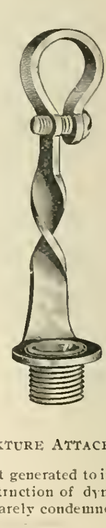
treated under the heads of illuminating power, consumption of carbons, diffusion of light, fixing and trimming, and arcs in parallel. In discussing the candle-power of arcs the author states that the actual mean spherical candle-power of a 2,000-cp nominal arc is probably not much more than 500, and that of a 1,200-cp nominal arc not much above 300; we note, however, that in the comparison of gas and electric lighting he says that "a 1,200 nominal candle-power arc lamp may be said to give out 480 candle-power when a thin ground glass globe is used"—a discrepancy of about 100 per cent if the absorption of the globe is considered. The final chapter is on the distribution of power, and while the treatment of the subject is rather perfunctory, the practical interpolations and illustrations give it considerable value.

The work seems to be based upon the note-book of an electric lighting engineer and extended by the inclusion of much matter of an elementary theoretical character more in place in the pages of a first book or primer of electricity. Aside from this, it contains much of interest and value to the electrician and engineer, and in its entirety can be recommended to those starting into practical electrical work who only care to know the simpler parts of electrical theory.

LAMP HOOK.

Lamp Socket Attachments.

We illustrate herewith a simple gas-fixture and a socket attachment, manufactured by the Independent Electric Company, 39th street and Stewart avenue, Chicago. The lamp fixture attachment illustrated is just being placed on the market under the name of the "Universal" and seems to have several specially good points. It can be readily and permanently attached to gas fixtures without breaking the gas joint, which [illegible]ry desirable feature. It can be bent in any direction without impairing its strength, and having no soldered joints, there is no danger of accident, even if fitted with a heavy shade. The neat appearance of this attachment as well as that of the socket hook, also illustrated, are in their favor, and the makers feel satisfied that they will meet with the merited appreciation from electricians.



FIXTURE ATTACHMENT.

A Reconstructed Station.

An object lesson is contained in the accompanying two illustrations showing how electrical apparatus apparently hopelessly damaged by fire can be repaired and made practically as serviceable as new machinery. Some time ago we noted in our news columns that a fire had occurred in the works of the Attleboro Steam and Electric Company, Attleboro, Mass., and Fig. 1 shows what was left of the works the next day. Notwithstanding the fact that the makers of the dynamos claimed that they were utterly worthless, Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, N. J., took the matter in hand and the result is shown in the illustration, Fig. 2, of the rebuilt station. The plant consists of eight 50-light arc machines, one 1000-light alternator, three 90-kw and two 100-kw generators, driven by a 450-hp and a 600-hp Harrisburg engines. Mr. H. M. Dagget, manager, and Mr. John Tregoning, late superintendent of the Thomson Electric Welding Company, who have charge of the plant, also deserve much credit for the energy and judgment displayed in reconstructing the station. Owing to the usual light construction of the station buildings in this country, there is not ordinarily in case of fire sufficient heat generated to injure the heavy masses of metal employed in the construction of dynamos any more than it would the engines, which are very rarely condemned as worthless.

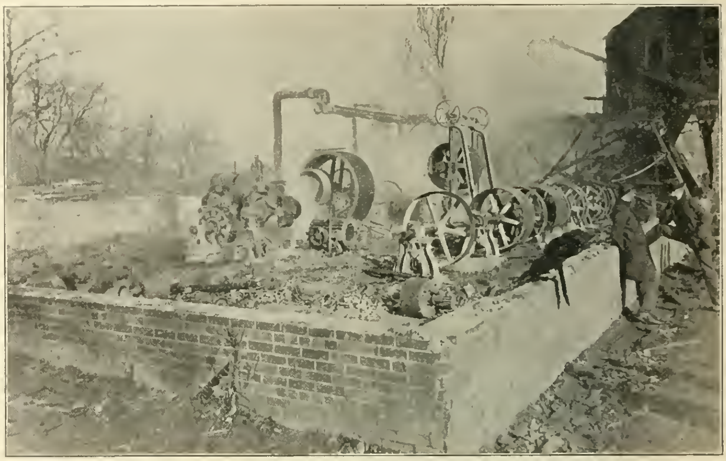


FIG. 1. BURNED-OUT STATION.

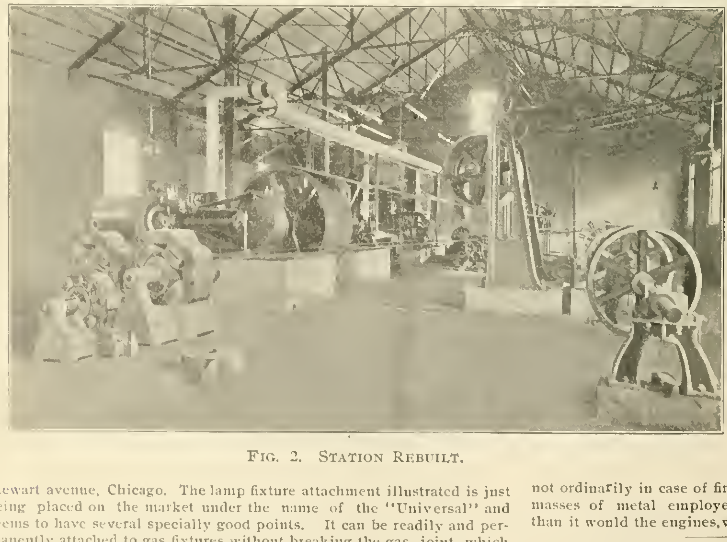
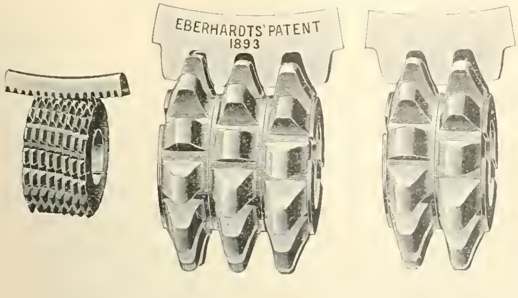


FIG. 2. STATION REBUILT.

New System of Cutting Gears.

We illustrate herewith a new system of radial cutters, originated and made by Gould & Eberhart, Newark, N. J., for the quick production

of perfect cut gears. Each cutter is made individually and with relieved teeth so that they can be sharpened as easily as the regular cutters, and without changing their form. With this system, it is claimed that ten to forty inches per minute of cutting is possible. The cutters



New System of Radial Cutter.

are made in gangs of from two to ten cutters, the number depending upon the pitch diameter and number of teeth in the gear to be cut. The cost of cutting gear wheels with these cutters is reduced to a minimum, and it is claimed that cut gears can with them be produced at as low cost as those with cast teeth.

Underground Conduits and Conductors.

Mr. Allan R. Foote has taken up the subject of Underground Conduits and Conductors for all classes of electrical service, with the object of producing a book on this subject that will not only give a faithful historical statement of what has been accomplished in this country in this department of electrical development, but also give the results of experience and a clear statement of the best practice of the day, for the information and guidance of those who are yet to make investments in underground construction, and for city authorities in formulating rules and permits. In order to complete this work quickly and have it, when done, of the highest degree of practical efficiency, Mr. Foote requests all persons who have had experience, or who feel an interest in the subject, to make suggestions to him as to the plan and scope of the work and also to indicate what information, based on experience or technical information, they are willing to place at the service of the public through the medium of the book. The address of Mr. Foote is P. O. Box 685, Washington, D. C.

New Atlas Engine.

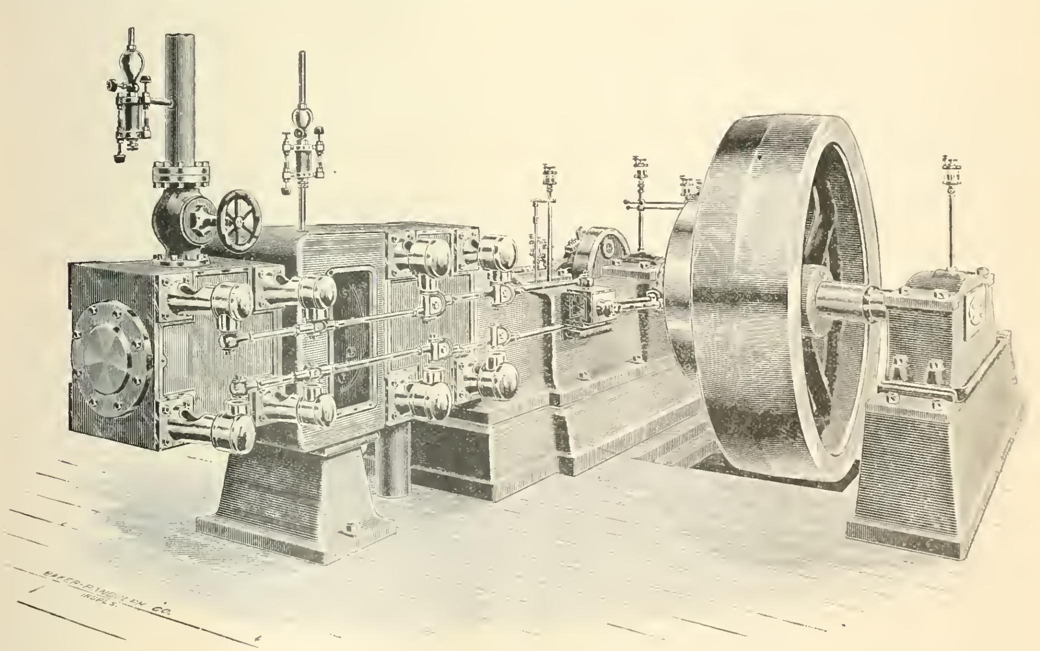
In recognition of the demand for better results in progressive steam engineering, the Atlas Engine Works, Indianapolis, Ind., has recently placed on the market a new engine, which we illustrate, under the name of the "Cycloidal Heavy Duty Engine."

The cylinder of this engine is of the four-valve type, with the shortest possible ports, and with a live steam jacket to prevent condensation. The valve seats are removable for inspection or renewal; the cylinder lining is also removable for repair or renewal, thus affording an important convenience for increase or decrease of the cylinder diameter to a reasonable degree. The steam valves are multi-ported, flat surfaced, tight wearing, quick opening and short traveling; they operate for any port opening with the least motion of a simple cycloid, are closed by steam pressure, and have no motion when under heavy pressure, and are removable for examination in three minutes' time. The exhaust valves are positive motion, multi-ported valves, operated by a fixed eccentric, and maintain a uniform compression under all load variations; they are also removable for examination or exchange of parts.

The mechanism operating the valves is stripped of all crab claws, trips and dash pots. Rods direct from the governor and two eccentrics work in lateral-motion simple cycloids for the steam valves, and cranks operate the exhaust valves. All are made of the closest steel and are free from perceptible wear; they are boxed in oil, conveniently accessible for care.

The main cross head is of the locomotive type and with abundant weight to take the impact of steam on the piston, equalize the pressure on the crank pin and diminish wear upon the piston and cylinder. The features of the valve-cross head are direct connection between eccentrics and valve rods, absence of objectionable rock shafts, and diminuition of wear by the mounting of one slide upon the other; only the differential motion occurs between the two. The connecting rod is a plain, heavy strap joint rod, the strap being the special feature. No parts are strained by bending, being built up of two sides and one end piece. The tenons on the ends, equal in strength to the sides, take the entire strain; the through-going bolts merely holding the parts together.

The main bearing is removable and has a diameter equal in inches to one-half the cylinder diameter, and a length measuring the same as the full diameter of the cylinder; the frictionless journal box can be taken out for renewal by simply jacking up the shaft and wheel. The governor is a strong roller bearing shaft of the inertia or dead wheel form, and controls the light weight, non-resisting balanced valves with so little effort that there is practically no variation in speed.



Cycloidal Heavy Duty Engine.

Electric Railway Equipments.

It is possible to-day to buy a car equipment for $850, which a year ago cost $1,250, and two years ago $1,650. While the profit is, of course, now much less than formerly, yet the reduction in labor, cost of material and management have been large factors in bringing about the decrease.

Financial Intelligence.

The Electrical Stock Market

New York, Dec. 22, 1894.

THE ELECTRICAL STOCK MARKET was infused with new life during this week, several of the issues of this class demonstrating that the old-time partiality of investors for them had not been quite forgotten. It has often been pointed out in these columns why electrical stocks which mainly represent manufacturing or operating companies whose business directly reflects trade conditions, should prove prime favorites with the investing class of Stock Exchange customers, and the renewed demand for these securities, at a time when the commercial soundness of the country is reasserting itself, fully bears out these assertions.

GENERAL ELECTRIC betrays no sign of weakness in the midst of the varied onslaughts on the active Stock Exchange list. The bear clique has endeavored to shake down quotations all around on what they are pleased to designate the poor outlook for business by reason of the currency straits of the Government, and the so-called "Industrial" group of stocks has been the chief sufferer from the vicious assaults of the bear contingent. But General Electric has refused to participate in any declines, and this is not remarkable when one hears the reports relative to the company's continued prosperity. There is one officer quoted as saying that the business during 1894 in street railway equipment will exceed that of 1892, which was the banner year. Various causes are put forth to explain this heavy increase in the demand over 1893. For one thing, it is possible to-day to buy a car equipment for $850, which a year ago was $1,250 and two years ago $1,650. That a car equipment can be produced at a profit for almost half of what it cost two years ago is surprising, but the great reductions in the price of labor and material, and economies introduced in manufacture, have so reduced the cost to the companies that a substantial margin of profit is afforded at even $850. But it is not likely that prices will remain very long at the present low level, and the hard-headed managers of the dozens of street railway companies contemplating changes in motive power are hastening to secure new apparatus at prices which they are realizing are sure to be greatly advanced within a few months. Hence the big demand for street railway motors. The General Electric's business in this line is steadily growing. November, generally the dullest of the year, has been the heaviest month ever experienced. Inside of sixty days the Chicago Metropolitan West Side Elevated Railroad, which has been equipped by the General Electric Company, will be running by electricity. Many roads—among them may be mentioned the Kings County Elevated, of Brooklyn, and the Manhattan Elevated, of New York—are awaiting with interest the outcome of this practical experiment. The two roads in question have made thorough examination into the cost and practicability of equipping their lines electrically, and the success of the General Electric system in Chicago will probably be followed by its introduction in the east. It is on such prospects that General Electric stock holds strong, and with reason.

WESTINGHOUSE ELECTRIC is benefiting from similar causes. Its business is uninterruptedly on the increase, although the orders on hand are in themselves sufficient to keep the works busy for a long time. A malicious attempt was made during the week to rig the stock on the Pittsburg Exchange. A raid was made on the report that the Westinghouse Electric employees had been notified that the two weeks' pay roll due last Saturday would not be paid for a week or so. Naturally there was hardly any truth in this and the fraud was discovered ere there was any chance to take advantage of the financial difficulty naturally inferred from the story. The facts of the case are these: Heretofore it has been the Westinghouse company's custom to pay every alternate Saturday; recently, however, a change was ordered in the pay day, necessitating the postponing of payments for a week. Financial considerations had nothing to do with the change, and to any one acquainted with the Westinghouse company's condition and its prospects the story was false on its face. The effect on the stock was hardly perceptible and that but for a moment.

AMERICAN BELL TELEPHONE stock broke wildly this week on the announcement that the courts had declared the Berliner patent void. The stock declined from 200½ to 191, but later rallied several points. Electrical experts insist that the adverse Berliner patent decision is a severe blow to the American Bell Telephone Company, as competitors are now able to make use of the valuable battery transmitter. The company's officials declare that the decision is only a temporary defeat. The case is to be immediately appealed to the United States Court of Appeals, where it will be argued as if it were an entirely new case. In the meantime the income of the company is not threatened, as, while the Berliner patent was a ground patent, the Bell Company has fully protected itself by specific patents on the details of exchanges. The decline in the stock has, however, complicated the matter of subscription to the new stock. Rights now have little if any value, the current market price being 11 or 12 cents. Before these rights can be transferred, stockholders must subscribe to the new shares at 190. If, therefore, the stock declines below 190, nobody will take it; this bears out the claim of the Company's officers that it is impossible to fix premiums on stock by legislation. The matter of subscriptious may, therefore, be seriously intefrered with by the new legal restrictious.

ELECTRIC STORAGE BATTERY CO., of Phila., stock continues on the uptack now that it has acquired control of the various storage battery patents. The subscription books of the company's preferred stock have been opened but it is not expected that the small stockholders will subscribe at present. If they do they are obliged to pay 50 for the preferred, which is above ruling market prices. The amount of stock now outstanding is $13,500 000 at par, of which $2,500,000 of preferred is in the hands of a trustee. It is proposed to sell $1,000,000, at par of the trusteed stock, or $500 000 and it is this issue that is now offered the stockholders and that is underwritten by the heaviest holders in the company.

. I . ON ELECTRIC ILLUMINATING, of New York, has been strong on the announcement that it will show considerable more than 6 per cent. earned on the stock for the year. The only thing keeping the stock down around par has been, it is said, the liquidation of some 15,000 shares taken from General Electric during the panic of 1893, which have been coming on the market ever since the stock recovered to par. Of late, too, there has been a deal of selling of the higher-priced bonds, the believers in the property putting the proceeds in the stock. Until July 21, 1895, the bonds can be converted into stock on ninety days' notice.

THE BOSTON EDISON ELECTRIC ILLUMINATING COMPANY stockholders, as announced last week, authorized the directors to increase the capital stock from $3,000,000 to $3,425,000, the new stock to be offered to stockholders at 100, one new share for every six now held. The current quotation is 120 bid.

ERIE TELEPHONE holds its own. The company reports a net gain of 74 subscribers for November, the total connected on December 1 being 16,006.

AMERICAN DISTRICT TELEGRAPH have decided to postpone action on their dividend until the annual meeting of the stockholders on January 24, 1895. A dividend of 1 per cent is reported earned but it was thought wise to defer payment for the present.

THE MEXICAN TELEGRAPH COMPANY has declared a quarterly dividend of 2½ per cent., payable January 12 to stockholders of record January 5. Books reopen January 14. The company's statement shows a surplus on October 1 of $378,292 and net earnings to December 31 of $62,171. As the dividend requires $47,815 there is an addition to the surplus for the quarter of $14 356, and there will be a total surplus after paying the January dividends of $392,642.

THE CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY has declared a quarterly dividend of 1¾ per cent. payable January 5 to stockholders of record December 29. Books re-open January 7. Quarterly statement shows: surplus October 1, $541,283; net earnings for December quarter, $179,656; dividend requires $110,390; surplus for December quarter $68,866; surplus after January dividend, $610,150.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	127	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101	102
" " " Brooklyn	100	109	112
" " " Boston	100	126	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	39	40
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	35¼	35½
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	33	34
" " pref	50	50½	51½

BONDS.

Edison Electric Ill., New York	1,000	108½	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	91¼	91½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	190½	191
American District Telegraph	100	35	40
American Telegraph & Cable	100	91	92
Central & South American Telegraph	100	102	105
Commercial Cables	100	130	145
Erie Telephone	100	50½	51
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	86½	87

ELECTRIC TRACTION stocks evidence increasing interest therein. This is probably due mainly to the rapid introduction everywhere of the electrical street railway, thereby making investors everywhere personally acquainted with the earning possibilities of electric traction stocks. It is commented on in a preceding paragraph how the cheapness of car equipments has resulted in a tremendous demand from all sections of the country for electric equipment for street railways. The economy of electricity as a motive power is becoming a more and more patent fact, and electric traction stocks must, with the continued introduction of electric roads, be a more and more important factor in the investment securities market.

ELECTRIC TRACTION STOCKS.

	Bid	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	66	69½
" " common	14½	15½
Long Island Traction	14	14
Rochester St. Ry	38½	40
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction	23½	25
New Orleans Traction	63½	65
Worcester Traction pfd	80	82
" " common	14	15½
Metropolitan Traction, Philadelphia	103½	1040
Philadelphia Traction	99	10
People's Traction	52½	53
Binghamton R. R. common	100	—

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. m. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	95	97
Binghamton Railroad Co. 5s	99	100

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Dec. 22, 1894.

MR. FREDRICK BATHURST sailed for Europe on Saturday as the accredited representative of the owners of the British Interior Conduit patents. Mr. Bathurst was an electrical engineer in England. Afterward he came to America and held an important position for about six years at Schenectady. For the last six months he has devoted his attention to studying the processes employed in the manufacture of interior conduit tubing. It will, therefore, be seen that he goes back to England well equipped for the work he has undertaken, and he carries with him the wishes of his numerous friends in America for success.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
December 21, 1894.

W. WORTH BEAN—and who doesn't know him—from across the lake, dropped in at THE ELECTRICAL WORLD office one day this week. Bean is as young as ever.

THE CHICAGO AND WORTH STREET RAILWAY COMPANY, Chicago, Ill., capital stock $2,000,000, has been incorporated by W. W. Beatty, J. H. Smith and M. Skinner.

THE MANUFACTURER'S ASSOCIATION of Cincinnati and Hamilton County, gave a very successful dinner at the Grand Hotel, Cincinnati, O., on Thursday evening, December 20.

THE SIEMENS-HALSKE ELECTRIC COMPANY says its business at the present time keeps it working night and day, and it does not see where the complaints of "hard times" come from.

THE WEBSTER ELECTRIC COMPANY, of Minneapolis, Minn., suffered loss from a fire in its store room at 11 Washington avenue N. The origin of the fire is not known. No insurance was carried. Although the loss was not great it is somewhat disheartening to a small firm in these dull times. The prospects of the company for the future, however, are bright and a good year in 1895 is expected.

THE WASHINGTON ELECTRIC COMPANY is in a quiet way building up a very handsome business. Its annunciator business alone is remarkably large for such a new firm, while its general contract business in work like manufacturing telephones, telephone switch boards and especially electric light and other devices for theatrical work, is gratifyingly large. It is one of the few places in Chicago where a man can go and have any kind of a job finished in first-class style.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has placed on the market a Leclanche porous cup, having the date on which it was made stamped on the outside. Everyone using the cup will appreciate this, as it is frequently a great convenience to be able to determine why a cell fails, or to know that it has failed much sooner than it should under ordinary circumstances. Knowing the date of its manufacture it is an easy matter to determine whether the difficulty rests with the porous cup itself. The Central Electric Company is now sending out the supplements to its large catalogue, giving over 100 pages describing electric appliances.

Oregon City, Wash., Dec. 14 1894.

JAMES G. WARNER now represents the Westinghouse Electric Manufacturing Company, in Tacoma, Wash., the Portland agency having been discontinued.

MR. T. A. SHOCK, formerly district engineer of the Northwest General Electric Company in Portland, Ore., is now superintendent of the Central Electric Railway Company of Sacramento, Cal.

SCOTT'S MILLS, ORE., now has an incandescent lighting plant in operation supplying street lights. The towns of Gervais and Dayton, Ore., have also decided to light their streets with electricity.

THE PORTLAND GENERAL ELECTRIC COMPANY has installed in "Station A," Oregon City, an additional railway generator, Edison type, having a capacity of 100-kw. The East Side Railway and the Willamette Falls Railway are operated by this station.

MR. AXEL ECKSTROM, of Lynn, Mass., who is representing the General Electric Company, of New York, has been in Oregon City lately, on business connected with the new electric station of the Portland General Electric Company at this point. He makes Portland, Ore., his temporary headquarters.

THE OREGON TELEPHONE AND TELEGRAPH COMPANY, of Portland Ore., has made arrangements, through Superintendent J. H. Thatcher, to install a telephone exchange in Oregon City. The central office will be located in the new Canfield building, and there will be about 25 subscribers the first month. Business is improving on the long distance lines of this company.

THE CITY OF PORTLAND, ORE., has just closed a contract with the Portland General Electric Company to light and heat the new City Hall, and also to operate the elevators. The contract price is $475 per month. The Portland Gas Company offered to furnish the same service for $425, but the electrical service was considered more satisfactory. There will be more than 1,000 incandescent lights in the building.

THE NORTHWEST GENERAL ELECTRIC COMPANY, of Portland, Ore. recently closed a contract to install a 300-light alternating machine of the T.-H. type, in the State Reform School in Salem, Ore. The company will supply the Willamette Pulp and Paper Company, of Oregon City, with a six-pole power generator of a special type, having a capacity of 300-hp, and designed to operate electric motors which will drive the company's paper machines.

THE NEW FIRM of electrical contractors, composed of H. C. Stevens, Jr., and C. G. Miller, have opened an office and supply house on Main street between Sixth and Seventh, in Oregon City. They also handle the supplies for the Portland General Electric Company's commercial circuits in Oregon City. The new firm has recently wired the Capen shoe factory for 60 incandescent lights, the Baptist church for 33 lights, and the Barclay building for 40 lights.

THE WILLAMETTE PULP AND PAPER COMPANY, of Oregon City, recently set in operation an electrical power installation comprising two T.-H. motor type railway generators, which supply current for a G. E. M. P. type motor having a capacity of 120-hp at 500 volts. The generators are located in the company's pulp mills about 200 yards from the motor, which is used to operate a new Pusey & Jones Fourdrinier machine just erected by Mr. Noble Heath, of Wilmington, Del.

THE SACRAMENTO POWER AND LIGHT COMPANY, of Sacramento, Cal. has closed a contract with the General Electric Company, of New York, for the equipment of an electric station in Folsom, Cal., from which current will be transmitted to Sacramento, 24 miles distant. The apparatus includes four 1,000-hp alternating generators, 3-phase system, which will be directly coupled to four 30-inch Smith & McCormick horizontal turbine water wheels. Four thousand horse-power will be transmitted at 11,000 volts.

THE POSTAL TELEGRAPH-CABLE CO., which recently completed its second transcontinental route through to New York, via San Francisco, Denver and Chicago, made a test of its lines December 2. Wires were successfully worked from Portland, Ore., to New York via the new Eastern route, and back to Portland via the old route, making a continuous circuit of nearly 8,000 miles. The new route starts eastward from Mojave, Cal., while the old line follows the Canadian Pacific route after it leaves the Pacific coast system.

THE PORTLAND GENERAL ELECTRIC COMPANY recently moved into its new general office building at the corner of Seventh and Alder streets, Portland, Ore. The office building will for the present consist of one story, 45 by 100 feet, containing suites of offices arranged in the latest mode, and an 18-foot basement, which will be utilized as the distributing station for the city. The transformers from the present sub-stations will be removed to the new building, and two new rotary transformers of 500-hp each will be installed there. The present capacity of the station is 8,000-hp.

ST. LOUIS, Dec. 20, 1894.

THE HEINE BOILER COMPANY are busy as ever spreading the fame of their water tube boilers.

THE WAGNER ELECTRIC COMPANY have one of the busiest factories to be found in the United States just at the present time. Their orders for transformers have piled mountain high, and they are working under unusual strain to keep up with the procession of requisitions constantly coming their way.

THE PLANTERS' HOTEL seems to be drawing immense crowds. Its electric lighting equipment is certainly one of the finest in the world, and does much to enhance the splendor of what may be catalogued as one of the grandest hotels ever constructed. Everything in and about the plant was supplied by the General Electric Company.

THE RANKIN & FITSCH ENGINE COMPANY, whose great engine in service at Atlanta every visitor to that city in connection with the recent convention remembers with delight, is building another monster for the city of Chicago, to go in the new power plant. This company is doing a large business with electrical equipments and build an excellent engine.

THE ST. LOUIS REGISTER COMPANY report things momentarily quiet in the register business; but they have an unusual number of inquiries on hand that will materialize into orders just after the holidays, when purchasing agents are a bit easier and not so afraid of making a big buying list for '94. The business of the company the past year has been very gratifying.

THE ELECTRIC CLUB held its annual meeting for the election of officers on the 19th, with the following result: President, Robert McCulloch; vice-president and secretary, Louis Nahm; treasurer, Capt. J. A. J. Schultz. Directors, A. S. Partridge, W. H. Bryan, W. L. Arnold, E. W. Moon, H. H. Humphreys and Col. E. D. Meier. Considerable comment was made on the fact that Mr. J. H. Rhotehamel was defeated for re-election as one of the directors.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY find business so good that they have been running night and day since September first, and have about completed arrangements for their new extension. This will more than double their present capacity, and will afford the company ample facilities for supplying their trade that now embraces all sections of the country. Mr. Louis Nahm stays at the helm and manages everything in his well known masterly style.

News of the Week.

TELEGRAPH AND TELEPHONE.

PAWTUCKET, R. I.—The work of building subways for telephone wires has commenced.

ROCK HILL, S. C.—The Rock Hill Telephone Company with a capital of $5,000, has been incorporated by A. R. Smith and John G. Anderson. The company is to operate a telephone system in the city of Rock Hill and in the county of York.

ANDERSON, IND.—The American Telephone Construction Company, with a capital stock of $200,000, was organized with Charles M. Harriman, president, and Fred Bradbury, secretary. The company will construct and operate telephone plants at Noblesville, Lebanon, Bluffton, Laporte, and Anderson. The American telephone system will be used.

ELECTRIC LIGHT AND POWER.

OWENSBORO, KY.—Bids will be received by W. F. Small for the erection of an electric light plant.

BALTIMORE, MD.—The Park Board is considering the question of an electric light plant of its own.

CEDARBURG, WIS.—J. W. Reader has been granted a franchise to construct an electric light and power plant.

WEEDSPORT. N. Y.—Mr. Burritt will erect a magnificent opera house in the spring, to be lighted by electricity.

SOUTH HAVEN. MICH.—The citizens will vote Dec. 17th, on the question of issuing bonds for establishing an electric lighting plant.

OSCALOSA, IOWA.—The Oscalosa Electric Light plant caught fire from the boiler room, and the entire plant, valued at $30,000, was consumed.

LONG ISLAND CITY, N. Y.—The Electric Illuminating & Power Company have been awarded the contract for lighting the streets by electricity.

BOSTON, MASS.—The Boston Electric Light Company is to erect a four story brick addition, 40x50 feet, to its plant on Head Place, to be used for storage purposes.

BALTIMORE, MD.—Officers of the C. & O. canal are discussing the plan of equipping the canal with electricity as a motive power. Will cost nearly $3,000,000.

JACKSONVILLE, FLA.—A committee of two members of the City Council has been appointed to visit two other towns where they have electric lights, and report on the advisability of erecting a plant here.

LESTERSHIRE, N. Y.—At the last meeting of the tax payers of the village of Lestershire, it was decided to have electric lights in that village, and the contract was let to the Binghamton General Electric Company, of Binghamton.

PORTLAND, ME.—The Tremont Improvement Company has been organized at Portland for the purpose of building and operating electric light, heat and power plants and supplies of electric railways, with a capital of $1,000. The president is E. F. Thompson, of Portland.

HASTINGS, PA.—Thomas J. McHugh, of Houtzdale, visited the town to look over ground preparatory to establishing an electric light plant, which he will erect here by February 1,1895. He has no doubt that he can secure contracts for 400 lights, the number necessary to begin with.

CHICAGO, ILL.—Bids will be received until Dec. 27, for the purchase of eight dynamos and 175 arc lamps, as per specifications in the office of the Superintendent of City Telegraph. Each proposal must be accompanied by a check for $500. H. J. Jones is Commissioner of Public Works.

CHICAGO, ILL.—Mayor Hopkins, Comptroller Jones, and City Electrician Barrett held a conference recently to consider bids for dynamos at the new electric light station, at Harrison street and Blue Island avenue. There was objection to the bids received, and it was decided to re-advertise.

TAMPA, FLA., is in favor of owning its own electric light plant. A council committee has found that the city could put in dynamos and a power plant for $15,000, but it recommended that only the wires, poles and lamps be set up now, and to advertise for bids to light the city for two or more years.

THE CITY OF MELBOURNE, Australia, requests tenders for the supply of an electric light plant, and in order to afford facilities for those interested, has forwarded to the office of THE ELECTRICAL WORLD specification sheets, copies of which may be had upon application by the prospective bidders.

WASHINGTON, D. C.—The Treasury Department is inviting proposals until January 3, 1895, for manufacturing and placing in position in the United States building at Cedar Rapids, and Fort Dodge, Iowa; Lowell, Mass.; Sheboygan, Wis., and Sioux Falls, S. D., combination gas and electric light fixtures. Additional particulars may be obtained by addressing C. S. Hamlin, acting secretary of the treasury.

ALBANY, N. Y.—At a meeting of the Common Council, Alderman Wagner presented a resolution accepting a proposition to have a special committee named, consisting of the president and four members, who shall report the cost of maintaining and establishing a light and power plant complete, to be owned by the city, which in addition to furnishing the necessary street lighting and such power the city may need, shall also furnish light and power for general purposes.

THE ELECTRIC RAILWAY.

HOT SPRINGS, S. DAK.—The City Council has granted a franchise for an electric railway.

PALMYRA, N. J.—The West Jersey Traction Company has been granted the right of way through the town. The company will maintain ten arc lights on its line witin the city limits.

MATAMORAS, PA.—An electric road will be built in this place without doubt. Mr. Warren K. Ridgway is interested.

FORT WAYNE, IND.—General Manager M. S. Robinson, has decided to equip all the street cars with electric headlights.

WOODBURY, N. J.—The Camden, Glucester & Woodbury Railway Company has obtained a franchise to lay a street railway.

ADOLPH SUTRO hopes to obtain permission to electrically equip his street railway line to Sutro Heights, in San Francisco.

PORT COLBORNE, CAN.—Leonard McGlashen and others have formed a company to build an electric railway from Port Colborne to Fort Erie.

NORWICH, CONN.—The Street Railway Company will petition the Legislature to extend its Laurel Hill branch to the residence of Jonathan F. Lester.

JACKSONVILLE, FLA.—It is said that the Fairfield road will be extended to Bucki's mill, and return to the city by way of the old line. This will make a belt line.

REVERE, MASS.—Residents of Beachmont and Crescent Beach are about to petition the West End Railway to extend its route from East Boston ferry to their homes.

BALTIMORE, MD.—The Traction Company will equip the Gilmore street line with electric power. Contracts have been awarded, and it is expected to be finished by January 15.

ELKHART, IND.—Elkhart citizens are petitioning the city Council to compel the Electric Railway Company to use iron trolley posts through the business portion of the city.

WALDEN, N. Y.—The Walden & Orange Lake Electric Railway has been granted permission to construct and operate an electric railway in the town of Montgomery and the village of Walden.

LEWISTON, ME.—It is said that a syndicate will ask the next Legislature to [illegible] a charter for an electric railway from this city to Augusta via. Sabattus, Leeds, Monmouth, Winthrop and Manchester.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company has asked permission to lay tracks in certain streets of the city. The Selectmen do not approve of it, and another hearing is to be held.

LEOMINSTER, MASS.—There is a movement on foot to bring about a plan to have the tracks of the West Street Electric Railway, when constructed, laid through Park street instead of on the north side of the common.

SENECA FALLS, N. Y.—The Board of Highway Commissioners is considering the application made by the W. S. F. & C. L. Railway Company for permission to construct a railroad on the new boulevard to the lake.

HUDSON N. Y.—At a meeting of the Common Council the Hudson Electric Railway Company asked permission to construct, maintain and operate a street surface railway with electricity as motive power in certain streets of the city.

TYNGSBORO, MASS.—The Lowell & Suburban Street Railway Company has petitioned the selectmen of Tyngsboro for a location to extend its electric road through that town to the New Hampshire line on the border of the town of Hudson.

SENECA FALLS, N. Y.—The Board of Trustees will consider the application made by the Waterloo, Seneca Falls & Cayuga Lake Railway Company for permission to construct and maintain an electric railway on Fall, Ovid, East Bayard and Stevenson streets.

BATAVIA, N. Y.—The Batavia & Northern Railroad Company has been incorporated, with a capital of $326,000, to construct a railroad 18 miles long, to be operated by steam or electricity, between Albion, Orleans County, and Batavia, Genessee County.

PORTLAND, ME.—The Legislature will be asked this winter to charter an electric railroad to run from some point in the city of Portland along the cape shore for 15 miles. The petitioners are F. Coleman Boyd, of New Haven, Conn., J. S. Winslow, and others.

READING, PA.—The Mohnsville and Adamstown Electric Railway has nearly completed its line, which is seven miles long and is practically an extension of the Reading and Southwestern Street Railway, although constructed under a separate charter.

NYACK, N. Y.—A conference of the parties interested in starting a trolley line to run from Sparkhill, through Nyack, to the Hook Mountain, was held, and it is said that the project was abandoned for the present at least. R. H. M. Dickinson, of Nyack, is interested.

WEST NEW BRIGHTON, N. Y.—The S. I Midland Railway Company has been consolidated with the P. R. & P. P. Electric Railway Company, under an agreement whereby an extension will be built from Castleton Corners over the Richmond turnpike and Jewett avenue to Prohibition Park.

MEDIA, PA.—The representatives of the Delaware County and Philadelphia Trolley Company and the street committee have held a conference, and permission was given to the company to lay its tracks on Washington street, as far as the tracks of the Chester and Media Trolley Company.

ROCHESTER, N. Y.—The Rochester Railway Company has made application to the Board for its consent to the construction, location, maintenance and operation of its railroad, tracks, poles, wires and other appliances in, through, along and upon the streets of the city. The application will be considered.

ATLANTA, GA.—Notice has been given that the following gentlemen will apply at the next regular meeting of the Council for a franchise to build and operate an electric street railway along and over certain streets of the city. W. A. Hemphill, Geo. S. Lowndes, A. J. McBride, Woodford Brooks, J. T. Voss.

NYACK, N. Y.—J. Hull Downing, President of the Northern New Jersey Railroad, will build a trolley road from the Nyack station of the Northern road to the Hook Mountain, or will extend the latter road and run a "dummy" on it as frequently as the people desire it, if the right of way can be secured without trouble or litigation.

NORFOLK, MASS.—The Norfolk Suburban Street Railway Company has completed its line from Readville to Forest Hill, a distance of five miles, and cars are running. It cost $29,000 per mile to build the 2¼ miles of track within the Boston city limits, and $12,000 per mile to build the 2¾ miles in the limits of Hyde Park.

NYACK, N. Y.—There has recently been much talk about the opening of a trolley line to Nyack, both from Sparkhill and the West Shore Railroad, but the matter has not taken any definite shape until this week. Now plans are being carefully considered, and it is expected that something more positive will be known about the project soon.

SIDNEY, O.—The Sidney Electric Railway Company, capital stock $100,000, will build a road through the village of Sidney, Shelby County, and westerly to the village of Laramie, and northerly to the village of Minister, Anglaise County. The incorporators are Charles Timmes, John Laughlin, J. H. Thedieck, William Piper, and John H. Wagner.

WETHERSFIELD, CONN.—The Hartford Street Railway Company will petition the Legislature for an amendment of its charter authorizing it to extend its lines in any of the highways of the town of Wethersfield, and to strike out the word "horse" in those sections of its charter relating to the making of contracts and leases with other "horse" railroads.

KINGSTON, CAN.—C. F. Gildersleeve, Kingston, president of the projected Kingston and Ottawa Railway Company, in Ottawa, says that the proposal to make the road an electric railway is now being considered by Mr. Drummond, of Montreal. No decision has been reached, because the question of operating long distance railways by electricity is as yet an unsettled one.

TOTTENVILLE, S. I., N. Y.—President J. Frank Emmons, Superintendent F. S. Gannon, and others connected with the Rapid Transit Railroad Company, attended a meeting of the Tottenville trustees recently, for the purpose of inducing the trustees to grant permission to the company to extend the tracks of the Staten Island Railway, at Tottenville, to the foot of Bentley street.

EASTHAMPTON, MASS.—William P. Latham, of Northampton, who has the contract for an electric road across the meadows, has commenced work. On account of the land of the railroad corporation being involved in the question of a new road from the Boston and Maine depot to King Bros.' silk mill, a hearing will have to be held before the County Commissioners before this road can be laid out.

MASSENA, N. Y.—Outside parties have been at work making a survey of the route from the Rome, Watertown & Ogdensburg depot at Massena to Dodge's Landing for a surface railroad, to be run by electricity. The object of the work and proposed lines it is not definitely known, but conjectured that the New

York Central desires to connect at that point with a line of steamers on the St. Lawrence.

ROCKVILLE, CONN.—The trustees of the Hartford, Manchester & Rockville Electric Railway voted to complete the survey of the road from Manchester to Rockville early in the spring. The company expects to have cars running to Rockville by next fall. Another company has capital secured to build an electric road from Rockville to Stafford Springs, as soon as the Hartford road is completed to this city.

AKRON, O.—Handsome summer resorts will adorn the banks of Turketfoot Lake and the West Reservoir. Frank A. Seiberling, acting for the Akron Street Railway Company, was granted permission by the State Board of Public Works, at a session of that body in Columbus, to use these State lands, and as soon as the proper franchise can be secured the construction of an electric line to these points will be commenced.

PHILADELPHIA, PA.—The entire length of Market street is now at the disposal of the Philadelphia Traction Company to introduce electric conduits preparatory to erecting a trolley system, as the Highway Commissioners Supervisors granted them permission to open streets from Twenty-third street to the Delaware river. The Manayunk and Roxborough Passenger Railroad Company have asked permission to lay tracks on Ridge avenue.

PROVIDENCE, R. I.—The electric railway connecting Attleboro with North Attleboro and Plainville, which has been idle for nearly a year, owing to the destruction of the power house and to litigation, was sold at auction for $51,000, on a foreclosure sale, the mortgage being $50,000. The purchaser was a syndicate composed of Marsden J. Perry, of this city; Lyman B. Goff, of Pawtucket; Clarence L. Watson, of Attleboro, Mass. and H. F. Barrows, of North Attleboro, Mass., and other well-known and wealthy men. The road will be immediately equipped and put into operation.

Miscellaneous Notes

THE NORTHWESTERN ELECTRICAL ASSOCIATION will hold its next convention at Milwaukee in January.

DR. PAUL SCHOOP is translating into German Prof. H. S. Carhart's book on primary batteries. The translation will appear in the spring with an additional section on primary batteries.

MR. FRED. W. DEGENHARDT died at Chicago on Dec. 7, after a brief illness. Mr. Degenhardt was the Chicago manager of the Standard Underground Cable Company, of Pittsburgh, and had many friends in the electrical field.

THE BROOKLYN ELECTRICAL SOCIETY has made arrangements with several prominent electricians to deliver lectures during the season commencing January 1. Members of the Brooklyn Engineers' Society will meet with the Electrical Society. Mr. Arthur A. Fish is secretary.

THE EDISON ELECTRIC LIGHT COMPANY, of Philadelphia, has arranged for a series of thirteen practical talks to be given in the lecture room of its station, 908 Samson street. The programme covers a wide range of practical subjects, and contains the names of men well-known in the electrical field. The idea is an excellent one and its execution will reflect much credit upon the company.

THE EDISON PHONOGRAPH PATENT DISPUTED.—Judge Lacombe, in the United States Circuit Court, on December 21, heard arguments upon the application of the American Graphophone Company against Cleveland Walcutt and others, for a preliminary injunction to prevent the defendant from selling or using the Edison phonograph on the ground that its manufacture is in violation of the American Graphophone Company's patents. The motion was argued by Lawyer Mauro, and it was claimed that the patents used in the phonograph which Edison has violated are "the sound record for sound waves and variations, a recording tablet and a tubular self-sustaining tablet for recording sounds or vibrations." Lawyer Dyer, on behalf of Mr. Walcutt, contended that there was no violation. Judge Lacombe took the briefs and reserved decision.

Trade and Industrial Notes.

THE CLINTON WIRE CLOTH COMPANY, Clinton, Mass., have just completed a new boiler house. The roof is of iron, covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

MR. JOHN MACCORMACK has severed his business relations with the Sterling Company, and will hereafter practice as a consulting engineer at 126 Liberty street in engineering or other expert mechanical work.

THE PHENIX ELECTRIC SUPPLY COMPANY, of Warren, O., has been incorporated by W. B. Swager and others to manufacture and deal in incandescent lamps and other electric supplies, and to supply electric power and light.

CHAS. A. SCHIEREN & COMPANY, 45-47 Ferry street, New York, have received a letter from the Hartford & West Hartford Railway Company, Hartford, Conn., saying that the twenty-four-inch perforated electric belts recently supplied them, are giving good service, and are very satisfactory.

J. JONES & SON, 67 Cortlandt street, New York, have issued a neat little expression of Christmas greeting, accompanied by a card, on which is tied a miniature paper bag from which protude a pair of turkey's legs, and along side of which is printed "Don't miss the stuffing." On the reverse side of the card is printed a wish bone.

MR. J. W. GODFREY, of 15 Cortlandt street, New York, room 38, has accepted the position of sales agent of the well-known Habirshaw wires manufactured by the India Rubber and Gutta Percha Insulating Company. Both Mr. Godfrey and Habirshaw insulation are so well known among electrical companies that both the company and Mr. Godfrey are to be congratulated.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has secured from the Naugatuck Malleable Iron Company, at Naugatuck, Conn., the contract for its new annealing room. The building will be 94 feet wide and 175 feet long, constructed entirely of fire-proof material. It is also building a new gas house roof for the Massachusetts Reformatory at Concord, Mass., and furnishing the iron work for the new office building of the Pope Manufacturing Company, at Hartford, Conn.

THE ELECTRIC ENGINEERING AND SUPPLY COMPANY, Syracuse, N. Y., has issued an 80-page catalogue devoted to electric light and street railway supplies. With very few exceptions the numerous articles described and illustrated are made by the company, and most of them are recognized as standards in American practice. We note a very large variety of porcelain goods, all of which are made from the celebrated Syracuse porcelain. Switches take up about half of the pages of the book, and of these almost every known form has its representative.

MR. LEMUEL WILLIAM SERRELL electric street railway contractor and engineer, Postal Telegraph Building, New York, has published a little pamphlet containing a quantity of useful electric railway data. The object of the book is to give data for the construction and operation of street railroads in such a form as to be intelligible to those who are not specially acquainted with this class of work. The matter is classified under the various heads of track and overhead construction, the car house, the power station, the equipment and the operation, with further classifications under each of these subjects. Throughout the pamphlet are illustrations of plants, etc., installed by Mr. Serrell.

THE FOSTER ENGINEERING COMPANY, Newark, N. J., has received a letter from Mr. A. S. Brown, the electrical engineer of the Western Union Telegraph Company, to the following effect: One of your four-inch "New class W. Regulators," placed in our dynamo room some six weeks ago, has been subjected to a series of carefully noted tests in actual service, and I am gratified to say the result is highly satisfactory. Steam is supplied through it to three engines, two of which are constantly running, driving with intermediate shafting forty-three dynamos. These dynamos furnish current to all the wires of this company running out of New York. Our tests show that under all conditions of varying initial steam pressure and of change of load there is practically perfect pressure regulation."

THE AMERICAN ELECTRICAL WORKS of Providence, R. I., is particularly happy in its advertising conceits, and the latest one is fully in line with previous successes. It consists of a card on which is mounted an envelope case around which, under the caption "All Comparisons are Odious," is printed the following: "Yet we must say that among our customers one only has first place in our esteem. We have (at great expense) secured a portrait (in colors) of our honored friend. We present it to you as a model. Study the features; see in this genial face how candor, joy, mirth and beauty are tempered by wisdom, justice and peace. Merit demands recognition. What we say of the original of this apotheosis of art is only justice. Upon opening the flap of the envelope we find—a mirror.

W. R. FLEMING & COMPANY, 203 Broadway, New York, and 620 Atlantic avenue, Boston representing the Harrisburg Foundry and Machine Works, Harrisburg, Pa., report the following sales made during the past few weeks. For the American Surety Company's new building, New York City, two 150 hp Ideal engines direct connected to two 100-kw dynamos, one 80 hp direct connected to 50-kw and two 50-hp direct connected to two 30-kw dynamos, for Edward J. Berwind's residence, New York City, one 50-hp Ideal engine; Norwalk Street Railway Company, South Norwalk, Conn. one 150 hp Ideal engine for electric railway service; exported to South Africa one 100 hp tandem compound Ideal engine; Yugo Isabel & Company, Guantanamo Cuba, one 30 and one 40-hp Ideal engine; Northport Electric Light Company, Northport, N. Y., two 100-hp Ideal engines and two 100-hp Harrisburg boilers with complete steam plant work; Albemarle Hotel, New York City, two 50-hp engines direct connected to two 25-kw M. P. dynamos; Fairfield Copper Co., Monroe, Conn., one 20-hp Ideal engine; Castle Square Theatre, Boston; two 50-hp and one 25-hp direct, connected to two 100 and one 25-kw dynamos; Keith's Theatre, Boston, three 150-hp direct connected to three 100-kw dynamos; Union Street Railway, New Bedford, Mass. one 500-hp compound engine and two 250-hp Harrisburg boilers and complete steam plant, for railway service, second order; Carpenter & Tremaine, Campbello, Me., one 20-hp Ideal engine; Amherst College, Amherst, Mass., one 80-hp Ideal engine; The Belknap Motor Company, Portland, Me., one 30-hp Ideal engine; Hartford City Gas Light Company, two 30-hp engines; The L. Candee & Co., New Haven, Conn., one 150-hp direct connected to two 50-kw M. P. dynamos; Bolkenhayn Apartments, New York City, one 130 and one 50-hp direct connected to 25 and 75-kw MP dynamos; Wharton & Williams, Newark, N. J., one 50-hp Ideal engine; O. B. Stillman, Boston, one 20-hp Ideal engine; General Electric company, Schenectady, N. Y., one 50-hp for direct connecting to a 25-kw M. P. dynamo; one 200-hp Harrisburg boiler (third order) for H. W. Johns Mfg. Co., South Brooklyn, N. Y.

Business Notices

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A RAILROAD DOCTOR'S PRESCRIPTION.—General Western Agent C. K. Wilber, of the Lake Shore & Michigan Southern Railroad, with headquarters at Chicago, is, without trying, one of the really funny men of the railroad world. The other day, for example, he accomplished this advertisement, which old hands at the business truly say is one of the brightest little things ever put on paper

R
The Lake Shoe Limited taken regularly on your Eastern trips will prevent that tired feeling so often experienced by travelers.
Leaves Chicago, V.XXX P. M.
Arrives New York, VI.XXX P. M.

C. K. WILBER.
Can be taken without shaking. W. P. A.

General Passenger Agent Daniels says that Dr. Wilber's prescription is equally efficacious on trains of the New York Central, he having this assurance from Drs. Cosby and Dumond, who have tried it with perfect success. General Passenger Agent Fee, of the Northern Pacific, has offered to all his local agents and subordinates a handsome prize in money for the best advertisement of the line, and it is obviously well for them that Mr. Wilber "isn't in it."—*Brooklyn Standard-Union*.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 18, 1894.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

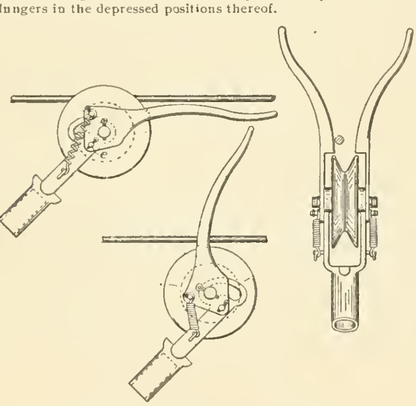
530,654. TROLLEY WIRE FINDER; F. F. and W. S. Muer, Newark, N. J. Application filed March 14, 1894. The combination of the trolley pole and wheel, with a trolley wire finder mounted on the pole, and fenders also mounted on the pole.

530,951. ELECTRIC CONDUIT; T. T. LaPointe, J. H. Flanagan and C. A. Thompson, New Haven, Conn. Application filed November 23, 1893. This comprises two head plates, one provided with a plurality of male, the other with a plurality of female fittings.

530,956. HAND OPERATING MECHANISM FOR ELECTRIC LOCOMOTIVES. A. W. Mitchell, Boston, Mass. Application filed April 14, 1892. The combination of the brake rod, gear secured thereto, a rack bar engaging with the gear, a rod turning in bearings arranged to be connected to the rheostat or controller of the motor and a gear secured to the latter rod engaging with the rack bar.

530,957. FINGER BOARD TELEGRAPH KEY; E. E. Mullinix, Burlington, Kan. Application filed July 31, 1894. The combination of a series of independently revoluble telegraphing wheels provided with peripheral symbol projections, and a single continuous movable press rod normally held in contact with the peripheries of all of the wheels and arranged to work over and onto a separate telegraph circuit or circuit closing key.

530,975. CIRCUIT CLOSER FOR BURGLAR ALARM SYSTEMS; A. Stromberg, Chicago, Ill. Application filed May 24, 1894. This comprises the covering of an opening, a pair of electrically connected plates thereon, a pair of plungers adapted to make contact with the plates and to be depressed when the covering is closed, and contact springs adapted to be engaged by the plungers in the depressed positions thereof.



No. 530, 654—Trolley Wire Finder.

530,976. BURGLAR-ALARM SYSTEM; A. Stromberg, Chicago, Ill. Application filed May 24, 1894. This comprises a protective circuit, a series of plugs and sockets for completing same, the plugs being provided with a grounded normally insulated terminal, and a testing battery and signal device adapted to be connected in circuit to determine the presence and location of faults in the circuit.

531,005. ELECTRIC CONVERTER; F. C. Priestly, San Francisco, Cal. Application filed February 16, 1884. The combination of a case, and a cut-out box set in top of and extending into the case.

531,018. SIGN ADVERTISING MACHINE; O. P. Briggs and W. R. Patterson, Chicago, Ill. Application filed January 26, 1894. The combination with lamps arranged to form words or characters and adapted to be successively lighted, of an automatically actuated pointer adapted to trace the words or characters as the lamps are lighted.

531,025. DANGER SIGNAL AND LOCK FOR SWITCHES; G. E. Edward's Brantford, Canada. Application filed June 16, 1894. The combination of a semaphore bell on the train, electrical connections whereby when the bell is operated the semaphore is set at danger, and connections from the semaphore to a lever on the platform whereby the rails must be locked against movement before the semaphore can be removed from the position of danger.

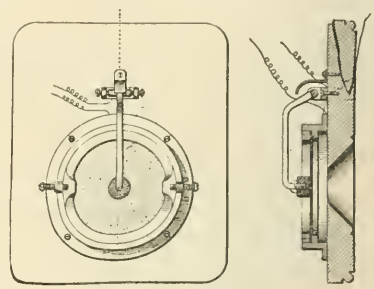
531,070. CONTROLLING DEVICE FOR ELEVATORS; A. B. See and W. L. Tyler, Brooklyn, N. Y. Application filed August 28, 1894. An elevator provided with a normally open-circuited shunt-wound motor, a controller on the car, connections for closing the circuit when the controller is operated and gradually increasing the speed of the motor, and a circuit closing device on the elevator for gradually varying the resistance of the field-magnet circuit.

531,077. COUPLER FOR ORGANS; C. Wales, Detroit, Mich. Application filed February 10, 1894. A coupling device comprising an electric circuit having movable terminals, and means for holding the terminals out of the path of the switch.

531,078. TELEPHONE SPEAKING TUBE SYSTEM; T. C. Wales, Jr. Application filed April 7, 1894. This comprises a plurality of stations and circuits, and a common source of current, switching and calling devices at each station, an electro-magnetic retardation coil in a branch conductor, and a call bell in the signaling circuit which is normally a derived circuit around the said electro-magnetic retardation coils.

531,143. APPARATUS FOR ELECTRIC HEATING, SMELTING AND SEPARATING; J. W. Woodfolk and J. C. Wharton, Nashville, Tenn. Application filed December 12, 1893. The combination with the furnace forming one electrode, through which acidulated water is circulated, of the other electrode, through which the material to be melted is passed, an exhaust fan connected to this electrode, and suitable connections for both electrodes.

531,146. SIGNAL LAMP FOR ELECTRIC RAILWAY CARS; C. H. Baker, Detroit, Mich. Application filed April 24, 1894. The combination with a rotary support of a trolley arm, of a signal lamp carried by the support.



No. 531,194.—Telephone Transmitter.

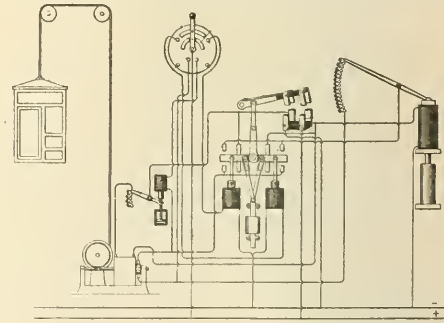
531,153. ELECTRIC METER; T. Bruger, Bockenheim, Germany. Application filed June 22, 1894. This comprises a rotary metallic body adapted to be rotated when subjected to intersecting alternate current fields with shifted phase.

531,188 SOUNDER; F. F. Howe, Marietta, O. Application filed January 15, 1894. This comprises separated cores, coils therefor, and a movable cross bar for connecting the cores at different points.

531,194. TELEPHONE TRANSMITTER; D. A. Kusel, St. Louis, Mo. Application filed August 6, 1894. This comprises a diaphragm holder, diaphragm, and clamping screws, the screws being adapted to be moved toward each other, a clamping ring adapted to be engaged by the screws to be forced into contact with the diaphragm, and an electrode adjacent to the diaphragm, and suitable connections.

531,214. ELECTRIC SAFETY APPLIANCE FOR RAILROADS; E. L. Orcutt, Somerville, Mass. Application filed November 2, 1893. This consists of electric circuits composed of the rails of the track and contact plates, a train mechanism consisting of a plurality of closed circuits, switching brushes to loop the track circuits into the train circuits and mechanism operated by the breaking of the circuits to automatically stop the train.

531,268. BRAKE AND POWER CONTROLLER FOR ELECTRIC CARS; A. W. Mitchell, Boston, Mass. Application filed January 22, 1894. This comprises a gear on the brake rod, a projection on the gear, a rack bar sliding in guide ways engaging with the gear and with the projection, and a rheostat arranged to be connected to the rack bar.



No. 531,070.—Controlling Device for Elevators.

531,284. ELECTRIC BLOCK SIGNALLING SYSTEM; A. J. Wilson, Port Chester, N. Y. Application filed May 14, 1894. This comprises a controlling circuit, track circuit controlling same, and a switch indicator connected in a bridge across the signal circuit, whereby the operation of the track circuit affects both the signal circuit and the indicator.

531,291 GUIDE FOR TROLLEY-WHEELS; W. H. Dickerhoof, Cincinnati, O. Application filed July 23, 1894. A trolley having its bearings capable of a vibratory movement thereon independent of the bearings, guide arms connected to the axis and pivoted to the bearings, and a yielding connection between the guide arms and bearing supports.